MAY, 1955

MAY 10 19

PIPE LINE INDUSTRY

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CONSTRUCTION • OPERATIONS • MAINTENANCE

Louisiana Line

Dragline at right is operating on TGT's new line in southern Louisiana, where thousands of empty oil drums were put to use as pontoons.

Page 58

When to Retire?

Growing numbers of senior employes call for a new look at retirement policies.

Page 36

Centrifugal Compressors

In pipe line use, design them for the future, but provide for the present.

Page 39

Turn page for additional contents and a Quick Review of this issue

Subscription price $2 per year

Single copy price 50 cents

in the manufacture of A. O. Smith Line Pipe . . .

Every fifth man on the production line is a

Quality control

SPECIALIST!

QUALITY CONTROL works full-time in the manufacture of line pipe at A. O. Smith. It's everyone's detail on his own particular job. But in addition, one out of every five employees is a *specialist in quality control.* These inspectors closely and constantly check each operation during production. Their department, independently responsible to management, has full authority to stop any operation for correction when necessary.

QUALITY CONTROL begins outside of A. O. Smith. At the steel mill, A. O. Smith technicians cooperate with mill inspection and control. QUALITY CONTROL continues in A. O. Smith Metallurgical and Testing Laboratories. Finally, from the pickled plate to the shipping platform, it scrutinizes and checks every operation in the manufacture of the A. O. Smith pipe.

QUALITY CONTROL that never leaves the production line is yours at no extra cost when you choose A. O. Smith line pipe. Remember — QUALITY CONTROL is as important to A. O. Smith as it is to the customer. Through it we seek to better serve our customers.

Through research . . . a better way

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MAY 10 1955

PIPE LINE INDUSTRY

CONTENTS and Quick Review

May, 1955 Vol. 2, No. 5

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Sun's Predicament—A National Warning!

☐ There is nothing sinister in the deal whereby an American company is importing into the U. S. oil purchased from a British company. The question of imports is ticklish for integrated companies. Production departments can present strong arguments against it, while refining departments desire to purchase crude at the cheapest possible price. Therefore, a "happy" medium must be found. These views are expressed in an editorial by PIPE LINE INDUSTRY's publisher.

By Ray L. Dudley.....Page 4

A New Look at Retirement

☐ An ever-increasing number of senior employes calls for a careful study of personnel retirement policies. And in conducting such a study, it must be remembered that human factors are important, too. Here are some ideas that will help you to arrive at some sound answers to the problems arising from population-age shifts.

By Irving Ladimer.....Page 36

Tailoring Centrifugal Compressors For Use on Today's Gas Pipe Lines

☐ A "natural" for modern gas pipe lines is the centrifugal compressor. It is reliable, efficient, simple to operate and maintain. Here are some design pointers that will help both engineers and operators.

By C. F. Koenig and L. J. Holveck.....Page 39

Intake Air Cooled for Better Engine Performance

☐ Cooling intake combustion air in hot climates improves engine performance by minimizing detonation and increasing horsepower. Just as automobiles function better on cool nights than on hot days, so engines will run better if the intake air is cool and moist. Here is a report from a company that got increased horsepower and efficiency out of engines by cooling the intake air.

By Lynn K. Finney.....Page 45

Turbocharging Two-Stroke Gas Engines

☐ Why should a two-cycle gas engine be turbocharged? The two-cycle gas engine must positively pump the air it uses for combustion and scavenging. Crankshaft power required to pump this air on non-turbocharged engines is a significant part of the total developed crankshaft power and total engine fuel consumption. Turbocharging is a practical means of relieving the engine crankshaft of this duty and at the same time, making an increase in mean effective pressure possible. For further details on turbocharging, read this article.

By Carlton A. Chamberlain and George A. Bollman.....Page 48

Coatings Will Protect Cooling Tower Headers

☐ Cooling tower piping headers provide a stern test for protective coatings. But a well planned set of specifications and strict inspection can make a good coating pay off. The annual cost of protection is only 18 percent of the uncontrolled corrosion bill.

By R. L. Elkins and G. O. Hult.....Page 54

Drums Buoy 6 Million Pounds of Pipe Line

☐ Empty gasoline drums were used to buoy as much as 6 million pounds of pipe at a time on a "push" through the marshes of south Louisiana. The job was Tennessee Gas Transmission Company's new line. The longest shove was 31,000 feet of 20-inch concrete-coated line weighing approximately 240 pounds per lineal foot. One of the novel features of this construction was the double stovepiping operation. Two joints at a time were added at the barge end of the line and double crews welded and coated the joints simultaneously.

By Donald M. Taylor.....Page 58

How 36-Inch Pipe Is Pickled and Coated

☐ Thorough cleaning with alkalies and acids and phosphatizing prepare pipe for internal epoxy resin coating. Internal coating of pipe promises cleaner gas lines and operating savings following construction. Here's an article that shows how it is done.

By Melvin A. Judah.....Page 64

Here's Why Employes Quit

☐ It costs a company from $80 to $600 every time an employe quits. So isn't it worth your while to learn why most people quit? Here is a scientific analysis of the WHY of separations in 48 companies.

By Dr. Willard A. Kerr.....Page 66

School Days Again for Gas Engineers

☐ Outstanding leaders in the gas industry will take on the roles of professors when the Tenth Annual Short Course in Gas Technology convenes next month at Texas A. & I. in Kingsville, Texas.....Page 74

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NEXT MONTH: The API Transportation Issue. The outstanding papers of the API Transportation Division Products conference in one package.

PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

Sun's Predicament---A National Warning!

We recently saw an editorial which heralded the signing of a 20,000 barrel-a-day import contract by Sun Oil Company with The British Petroleum Company (formerly Anglo Iranian) as meaning that a non-producer of U. S. crude has got a foot in the door of American imports.

We take a different view of the matter. It is an American oil company, the Sun Oil Company, which is importing the oil. And out of the 235,400 barrels a day of crude refined in the U.S.A. by Sun in 1954, Sun produced 110,800 barrels a day (net), bought 106,560 barrels a day (net) domestically, and further bought 15,100 barrels a day from outside the U.S.A.

We see nothing sinister in the deal. We see nothing new in principle in the deal. If other U. S. oil companies are to import oil, why not Sun or any of the other considerable number of U. S. refining companies which also buy as well as produce U. S. crude.

•

The thing which is of peculiar interest to us is why Sun Oil Company should be *buying* oil outside the U.S.A., instead of *producing* more of it outside the U.S.A.! We recall that Sun was one of the companies which early went into Venezuela—very close to but not at the right spot. Sun spent 11 years and a lot of money in its 1921-1932 Venezuelan venture—with no oil to show for it. This might well discourage even as well an administered oil company as Sun. But, Sun Oil Company is seeking its own "foreign" oil production. In fact, Sun produced nearly 1500 barrels daily last year from its holdings in Canada.

In addition to its efforts in Canada, Sun is interested in several other countries as possible places to enter the search for oil, including Venezuela.

The matter of imports is a ticklish one within an integrated oil company. Production department executives may feel that every barrel imported (whether it be 12-gravity asphalt base or higher) means one less domestic barrel will be produced by the production department.

On the other hand, refining department executives are interested in buying crude oil at the cheapest possible price, regardless of its source, to make the highest dollar return on products manufactured and sold from the crude it purchased.

While the manufacturing department could show a higher profit margin by buying foreign crude that can be delivered to the East Coast cheaper than its domestically produced crude, this practice would reduce—and even eliminate—profits of the producing department. Therefore, a "happy" medium has to be found.

•

in discussing the decline of an over-all 10.7 percent in Sun's net earnings during 1954, President Dunlop states in the company's annual report that the reduction in profits was due primarily to allowable production cutbacks in Texas and Louisiana and that the net income of the oil division (excluding the decline in earnings of Sun Ship) declined 8.7 percent.

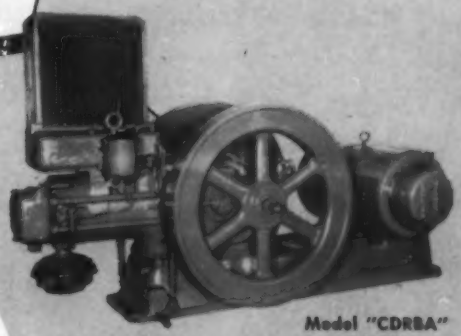
After discussing the amounts of the cutbacks in his annual statement, Dunlop said:

"Thus Sun was forced to purchase approximately 30,000 barrels a day to make up for the

Continued on Page 6

Install a WITTE *Electric Generator Unit*

for your microwave communications



Model "CDRBA" DIESEL

THE DEPENDABILITY OF THESE UNITS EQUALS THAT OF COMMERCIAL ELECTRIC POWER

Witte Power Units, successful in oilfield applications everywhere, are now teamed with electric generator units to provide automatic prime or emergency power for pipe line microwave equipment. They are an ideal solution to your hill-top station power problem with their low-cost operation.

Units are available to operate on diesel fuel, gasoline, natural gas, bottled gas, or kerosene. This makes it possible to select the cheapest fuel available for an economical installation.

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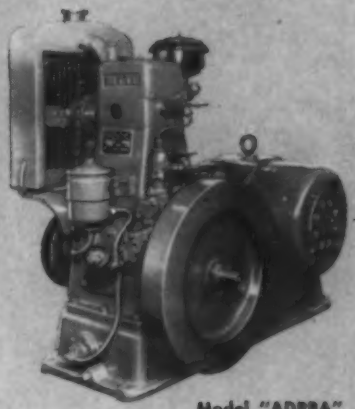
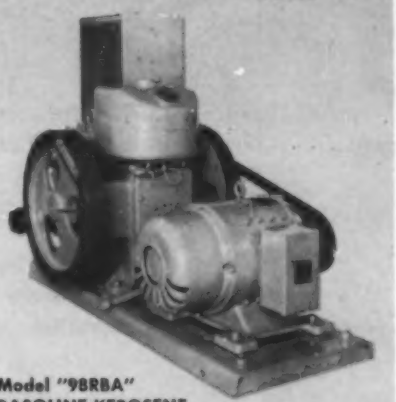


Model "ADRBA" DIESEL

CHECK THESE SIZES FOR YOUR REQUIREMENTS

Model	Fuel	Engine rpm	Engine hp	Generator rpm	KW Range
"9BRBA"	Gas-Gasoline Kerosene	1,200	9	1,800	5.4
"ADRBA"	Diesel	1,500	5.5	1,800	3.0
"LDRBA"	Diesel	1,350	8.6	1,800	5.4
"BDRBA"	Diesel	900	7.8	1,800	4.9
"CDRBA"	Diesel	750	12.2	1,800	7.7

RATINGS BASED ON 24-HOUR-A-DAY OPERATION



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Full diesel — Models from 3.75 to 12.5 hp.

USS

UNITED STATES STEEL

AN EDITORIAL . . . *continued*

crude oil shut in during the year in its wells. Had your company been permitted to produce this oil, instead of having to buy an equivalent amount at relatively high crude prices, its net earnings would have been at least $10 million higher than they were. This experience illustrates the severe impact which the consequences of foreign oil imports have had on a refiner of domestic oil . . ."

•

The following comments are condensed from statements appearing in President Dunlop's annual report:

Texas wells produced 194 days last year, compared with 236 days in 1953. This, plus cutbacks in other states, cut Sun's domestic production to 110,800 (net) barrels daily in 1954 from 117,700 barrels a day in 1953; and

Sun's wells in 1954 were capable of producing at least 140,000 barrels a day without injury to the fields.

This last comment is the source of President Dunlop's statement that "Sun was forced to purchase approximately 30,000 barrels a day to make up for the crude oil shut in during the year in its wells."

This is an editorial, and the following is an expression of opinion we believe to be founded on sound reasoning:

> *The cutbacks in production in several states in 1954, occasioned by stock reductions and imports, went too far. A healthy domestic oil industry cannot be expected if they are repeated in 1955.*

Ray L. Dudley

PIPE LINE INDUSTRY

Specialized oil publications of THE GULF PUBLISHING COMPANY, 3301 Buffalo Drive, Houston 6, Texas; Box 2608, Houston 1, Texas. Cable Address: GULFPUBCO.

PIPE LINE INDUSTRY for the oil and gas pipe line industry.

WORLD OIL and THE COMPOSITE CATALOG for the drilling-producing-pipe line industry.

PETROLEUM REFINER and THE REFINERY CATALOG for the refining-natural gasoline-petrochemical industry.

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A. L. BURNS, Vice President, General Manager

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Single copies 50 cents (except special issues). Double price for single copies more than a year old. Subscription price: domestic and foreign $2 a year; 2 years, $3; 3 years, $4. Subscription restricted to those engaged in the pipe line branch of the oil and gas industry, or the manufacturing and distribution of pipe line equipment.

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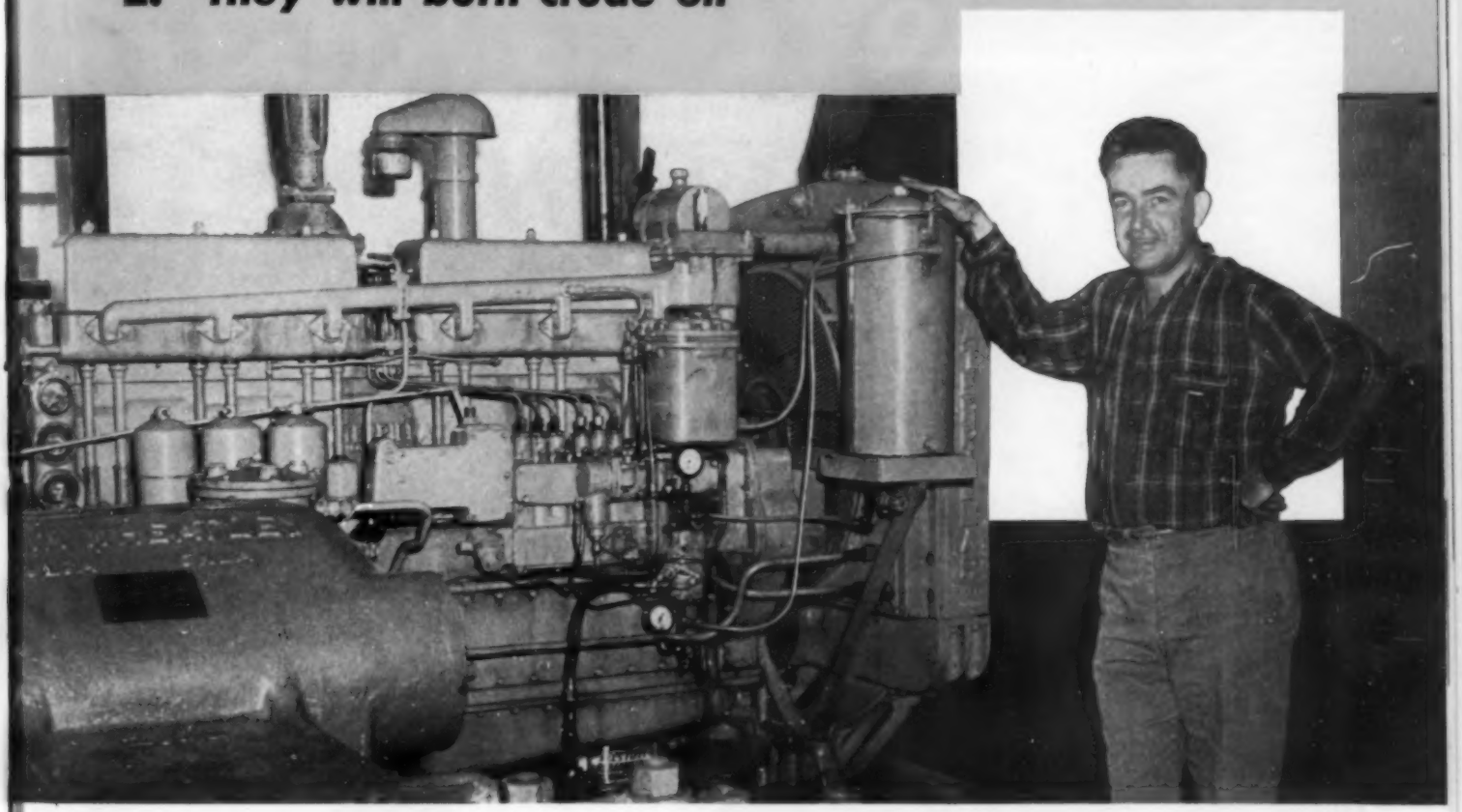
The Superintendent defines Caterpillar economy

1. "Our engines require practically no maintenance"

2. "They will burn crude oil"



Three CAT* D13000 Pumping Engines have been at work for the B.A. Saskatchewan Pipeline Ltd., Stoney Beach, Sask., for well over 15,000 hours. Their performance still brings a smile to the face of Plant Superintendent Jim Tennant.

"We are well pleased," he explained. "They are economical to operate since they require practically no maintenance and burn crude oil."

Here's the reason for his statement: All Caterpillar Pumping Engines stay on the job 24 hours a day without an experienced engineer hovering over them. They are practically adjustment-free. For instance, you never have to tinker with the fuel system. It needs no field adjustment or balancing.

And you don't have to worry about harmful dust and abrasives wearing out Cat Engine parts. Caterpillar's fuel filters, air cleaners and seals keep foreign matter out of the engine. And the engine's full-flow lube oil filter system cleans all lube oil just before it goes to the bearings.

How important is this detail? Caterpillar research has proved that three ounces of dust in the lubricating oil can completely wear out an engine in less than 1000 hours. Caterpillar Engines are filter-guarded against premature wear and unnecessary down time.

Your Caterpillar Dealer can show you pumping engines in 11 sizes up to 520 HP. Whatever your need, there is a Caterpillar Engine for *your* job.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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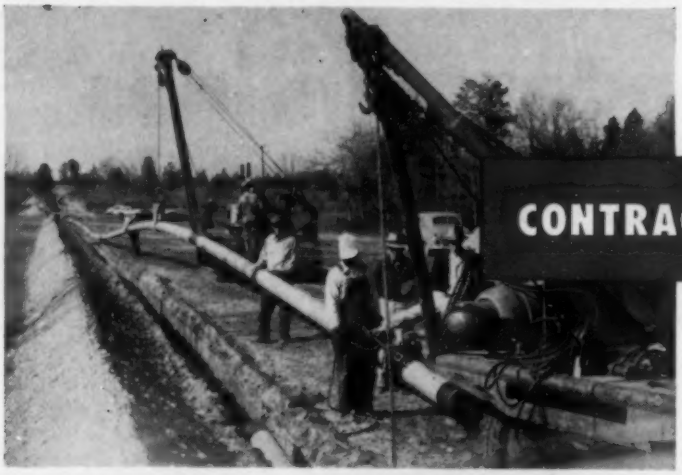
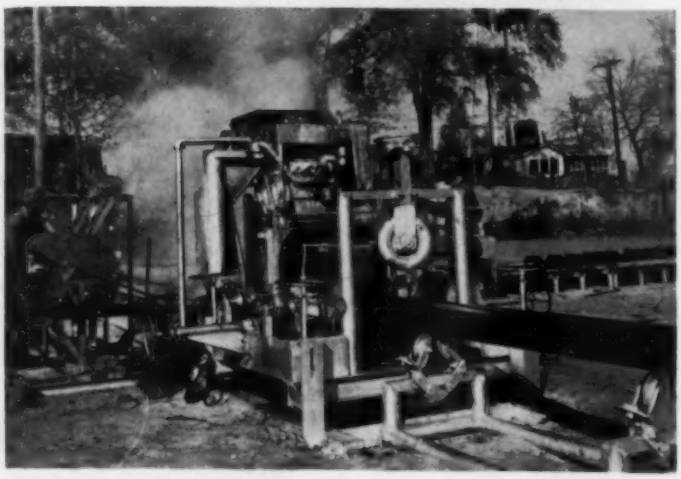
MODERN HEAVY-DUTY POWER





CONTRACTORS LIKE TO WORK WITH IT

J&L SEAMLESS LINE PIPE

The entire industry has respect, and rightly so, for J&L A. P. I. Seamless Line Pipe.

It meets or exceeds all A.P.I. Requirements and has exceptional weldability. Beginning at the mines, the J&L objective is a product with definite advantages for the customer and his contractor.

The photographs on this page show construction activities along an 8⅝" pipe line in southeast Louisiana and southwest Mississippi. Note how easily and safely the J&L line pipe takes the bends. Contractors like to work with it, and owners like the extra service dividends.

J&L PIPE

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SUPPLY DIVISION — TULSA, OKLAHOMA
Serving The United States and Canada

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315 MILES OF 36-INCH - - FOR LOOPS IN 1955

That is the amount of 36-inch line Transco will lay as part of 580 miles of pipeline loops to be completed before the winter heating season. In 1954, Transco laid 47 miles of this large pipe in Mississippi and Alabama. 36-inch pipe, with the same compression, will transport 60% more natural gas than a 30-inch line and almost three times as much as a 24-inch line.

A Transco innovation is the installation near Houston of a centrifugal compressor driven by a four-cycle gas engine.

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J-M Trantex Tape is cold-applied, sticks on contact, bonds to enamel

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- Overhead piping

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Wherever pipe lines require a long-lasting, corrosion-defying protective material . . . and easy, quick application is important . . . Trantex Tape is ideal. This pipe line coating can be applied by hand or with simple wrapping devices. No need for heavy-duty equipment or trained personnel. Trantex Tape sticks on contact, forms a firm, stable bond on either pipe or enamel . . . conforms to irregular surfaces.

In addition to on-the-job application, Trantex Tape is widely used on field-welded joints of mill-wrapped pipe to provide corrosion protection at these critical points.

Johns-Manville TRANTEX *polyvinyl* TAPE

PROTECTS PIPELINES AGAINST CORROSION

Just 3 cc. of Santolene C per 55-gallon drum STOPS PIPELINE RUST!

One treatment does the trick! Santolene C protects metal surfaces from refinery to consumer, cuts maintenance and overhaul costs caused by rust, saves up to $70,000 a year on steel replacement in a single tanker! Soluble in oil and compatible with other additives, burns with fuel. Available in tank cars and 55-gallon drums.

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SERVING INDUSTRY . . .
WHICH SERVES MANKIND

GREAT NEWS
About a new development by STEWART & STEVENSON to reduce your welding costs

Designed specifically for steel construction service by America's most experienced producers of portable diesel electric sets.

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Check these features:

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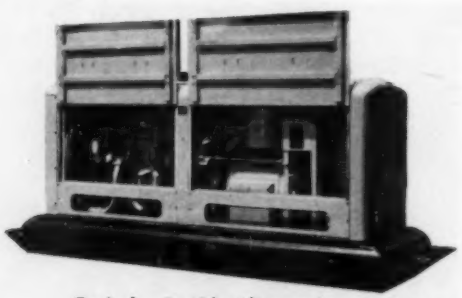
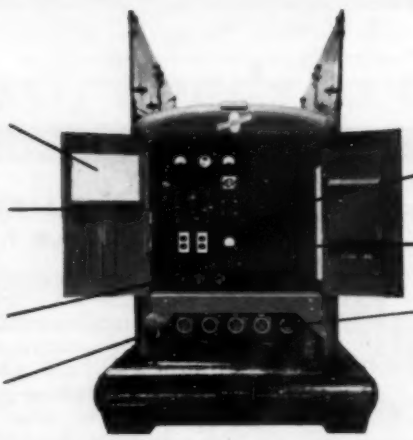
3. Retractable lifting eye for easy loading and unloading.
4. Weather resistant enclosure with large sized access panels. Hinged panels provide easy access without the possibility of being misplaced or damaged.
5. Instant starting without necessity for warm up.
6. Conservative ratings — All Stewart & Stevenson units are guaranteed to produce 25% more than their normal ratings.
7. Long Life — Stewart & Stevenson units operate at slower piston speeds, resulting in long life and low maintenance.
8. Compact Dimensions — Stewart & Stevenson units take up less space and are lighter in weight than competitive units.
9. Wide selection of sizes ranging from 43 KW (4-400 AMP machine normal capacity) to 200 KW (20-400 AMP machine normal capacity).

Streamlined weather resistant enclosure provides adequate protection against elements.



Typical unit with side panels open.



Wiring diagram and brief instructions.

Heavy duty automatic voltage regulator - shock-proof mounted.

Engine instruments, including starter switch.

Vernier type throttle control.

Automatic overload protector and disconnect breaker.

AC lighting plug-in circuits.

Welder and air compressor receptacle.

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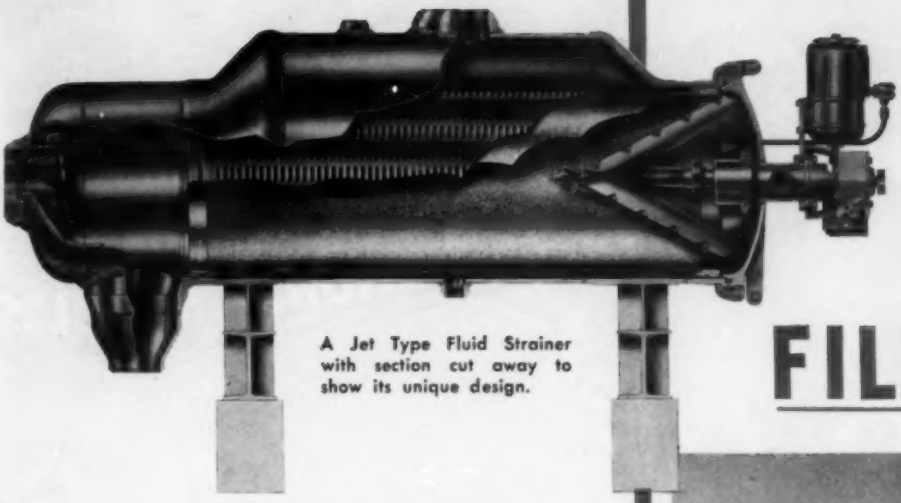
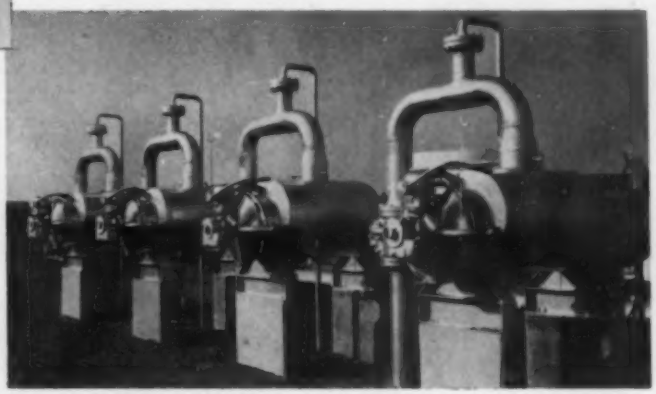


A Jet Type Fluid Strainer with section cut away to show its unique design.

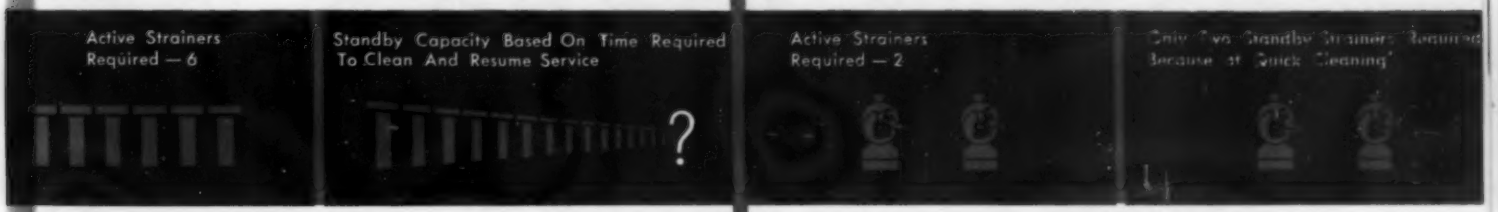
WHAT PRICE FILTRATION?

Let's examine two installations required to handle 60,000 bpd: One with conventional vertical sock type strainers of approximately 10 square feet of filter area each; the other with Jet Type Horizontal Strainers of approximately 30 square feet of filter area each.
Required: One square foot of filter area per 1,000 bbls. per day or a total of 60 square feet of filter area with **adequate** standby capacity to assure no by-passing, at any time, of dirty strainers, or pipeline shutdown time for cleaning strainers.

OBJECTIVE: To filter all the product, all the time.*



An installation of four, 30,000 bpd capacity Jet Type Strainers on a new products pipeline.


Active Strainers Required — 6
Standby Capacity Based On Time Required To Clean And Resume Service
?
Active Strainers Required — 2

INSTALLATION REQUIREMENTS

1. Valves — 3 Per Strainer
2. Extensive Manifolding
3. Installation Labor — Maximum
4. Overhead Crane for Lifting Closure and Basket
5. Sump
6. No Recording Instruments

STRAINER MAINTENANCE

1. Cleaning — Remove Closure and Replace Felt Manually. (Two Men 30 Minutes, 1 Man-Hour)
2. New or Reconditioned Felt Required for Each Cleaning
3. Replacement of Collapsed Strainer Elements Due to Excessive Pressure
4. No Automatic Operation Possible

*The expense of complete filtration is more than justified by the prevention of damage to closely fitted mechanical devices necessary to the operation of a pipeline.

INSTALLATION REQUIREMENTS

1. Valves — 3 Per Strainer
2. Less Manifolding
3. Less Installation Labor
4. No Overhead Crane
5. Sump
6. Pressure Differential Recording Gauge to Assure Daily Record of Pipeline Operation.

STRAINER MAINTENANCE

1. Cleaning Accomplished By One Man in **Less Than 5 Minutes** Without Opening Strainer
2. Stainless Mesh Screen Lasts Indefinitely
3. Alarm System Prevents Damage to Strainer Element Due to Excessive Pressures
4. Can Be Made Fully Automatic

ADDITIONAL OPERATING ADVANTAGES OF JET STRAINERS

1. Stream can be cleaned to any desired degree — 100, 200, 325, or 400 mesh screens optional.
2. Can be made fully automatic for operation at remote station.
3. Greater Safety — Strainer is cleaned without opening, consequently workmen are not subjected to danger of fumes and fire.

THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

Another submarine crossing for NATIONAL SEAMLESS..

Welded sections of National Seamless Pipe being ramped into the river from the lay barge. Barges at left assisted in laying-in operations. In the background is the huge 212-foot dredge used in the crossing.

This 18-inch diameter, 1⅛-inch wall National Seamless Steel Pipe weighed 208 pounds per foot. Due to its thickness, weights and special coatings were unnecessary.

The ramp of the lay barge. Welding of this heavy-wall pipe was slow—taking about four hours for two welders to complete one weld, using 3/16-inch rod.

National Seamless Pipe being welded into 80-foot sections on the river bank. The dredge is at work in the background. An estimated 3,000,000 cubic yards of earth had to be dredged to prepare a ditch for the pipe.

WALLS WITHOUT WELDS

TENNESSEE GAS TRANSMISSION COMPANY LAYS THREE 18-INCH LINES OF NATIONAL SEAMLESS PIPE ACROSS MISSISSIPPI RIVER

This new crossing of the Mississippi consists of three lines of National Seamless Pipe, laid parallel, 100-feet apart in a downstream loop in the bed of the river. On either side of the river, the three lines tie into the Tennessee Gas Transmission Company's new 576-mile 30" O.D. line, running from the Kinder, La., compressor station to Portland, Tenn. The Kinder-Portland line gives the company a direct connection for moving gas from south Louisiana and the Gulf of Mexico to eastern markets.

The preliminary preparations consisted of cleaning, priming, coating, and double-wrapping the 18-inch National Seamless Pipe. It was then welded into 80-foot sections on the river bank, and transferred to a barge. As the pipe was needed, it was transported to the laying barge in the river, where the 80-foot sections were welded together in a continuous line. A huge ramp on the laying barge was then used to ease the pipeline into the water.

Submarine crossings are among the most difficult and costly of pipeline installations. A suitable crossing spot has to be chosen very carefully. Dredging operations sometimes entail the moving of millions of cubic yards of earth. And once the pipe is laid, it has to be there permanently. It must withstand great pressures, absorb distorting and bending stresses. To do this, the pipe has to be strong, and extremely flexible. It has to be "trouble-free" for years and years to come. In short, it has to be USS National Seamless Steel Pipe.

NATIONAL TUBE DIVISION
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

NATIONAL SEAMLESS PIPE AND TUBES

IN RIVER CROSSINGS TOO — SEAMLESS DOES IT BETTER

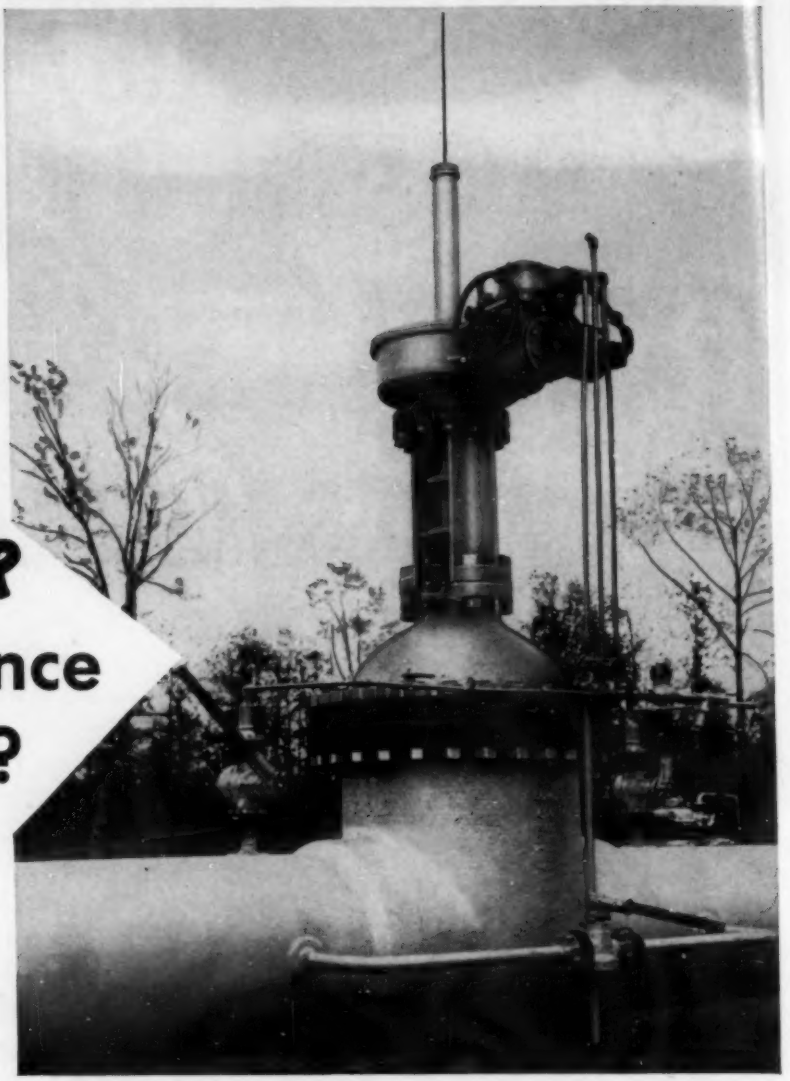
USS

UNITED STATES STEEL

DARLING

VALVES

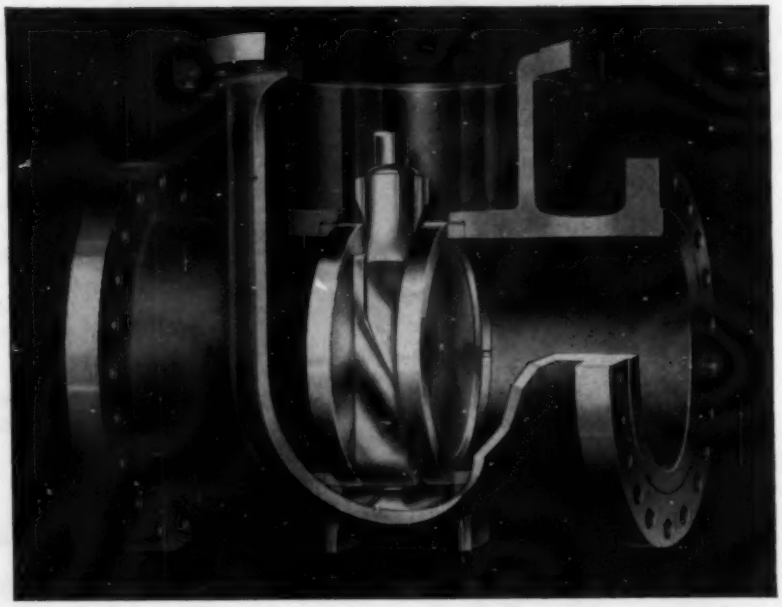
What's *SURER* valve performance worth to you?



IN your service, the thing about valves that costs the most is down time. Right? And sometimes even *preventive* measures are pretty costly, too!

All right, here's a fact that Darling gate valve users everywhere will vouch for. The Darling *fully revolving double disc, parallel seat principle* means *easier* operation, *surer* closure, less chance of trouble, month in, month out. And you'll save on maintenance all along.

Why not check into Darling gate valves for your requirements? Find out *how* they assure these advantages. We'll gladly furnish general or specific details. Just say the word.



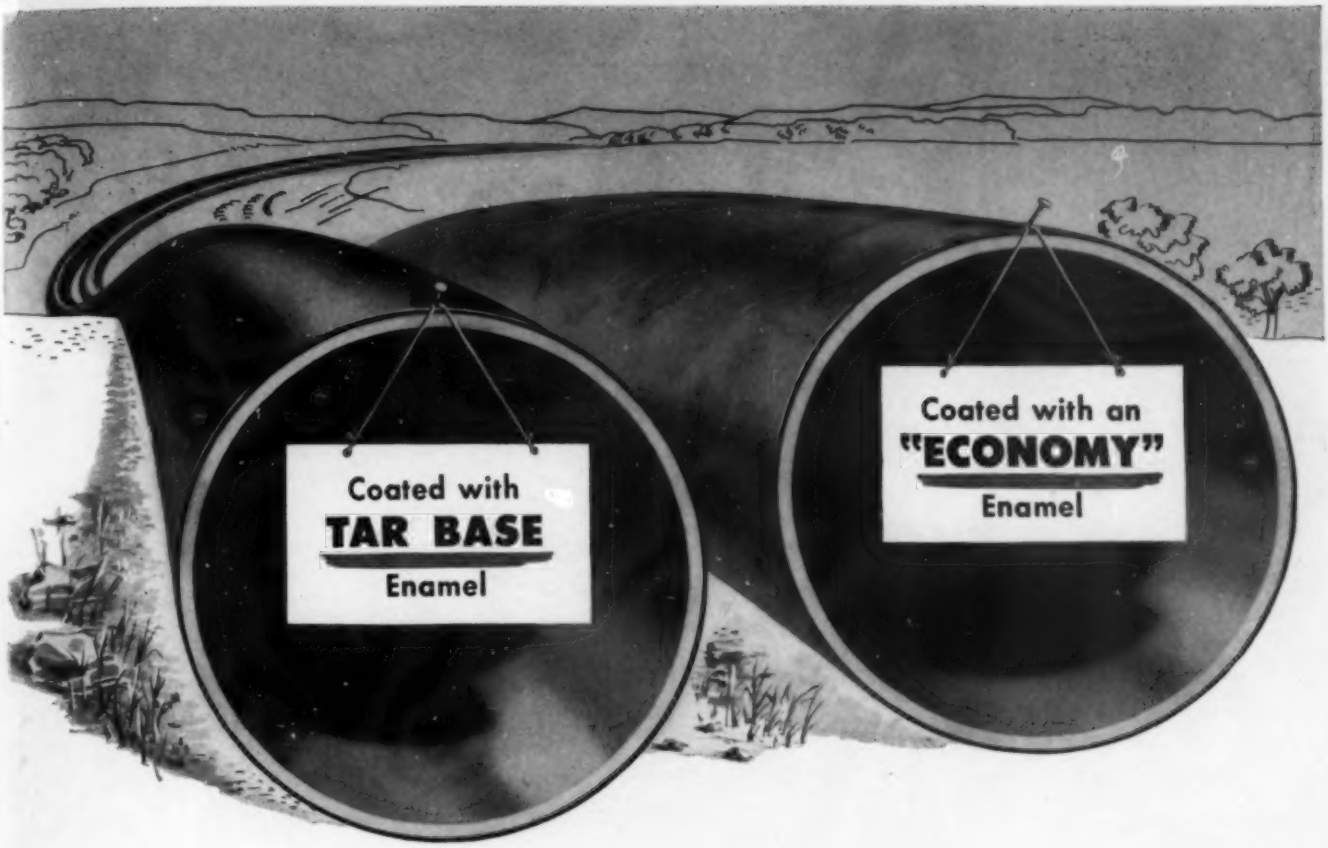
Above top: Darling 30" motor-operated gate valve powered by gas from line pressure.

Cutaway, below, shows simplicity of Darling's unique fully revolving double disc parallel seat gate valve principle—just four simple working parts—two plain interchangeable no-pocket discs and two husky wedges.

DARLING VALVE & MANUFACTURING CO.

Williamsport 27, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



Which Coating will be a "Bargain" 10 YEARS FROM TODAY?

IF you measure a bargain in terms of first cost *plus* yearly upkeep and maintenance, you'll come up with only one answer: Tar Base Enamels. For these tough, durable enamels have *proved* their ability to resist soil stress and water absorption —two principal reasons why "economy" coatings fail and cause maintenance expenses to soar.

Why risk a large, long-term investment to "save" a few first-cost dollars on your protection bill? Specify *Pitt Chem* Tar Base Enamels, just as scores of leading pipeline companies do each year, and be *sure* of economical, longer-lasting protection.

When you buy *Pitt Chem* you buy *assured* pipeline protection with every drum, because *Pitt Chem* Tar Base Enamels are manufactured to rigid, *published* specifications by a basic producer. Write today for further information or technical assistance.

W&O 5523

PITT CHEM® TAR BASE ENAMELS

- Standard Grade • Modified Grade
- Plasticized Grade • Hotline
- Cold Applied Tar Base Coatings

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Grant Building • Pittsburgh 19, Pa.

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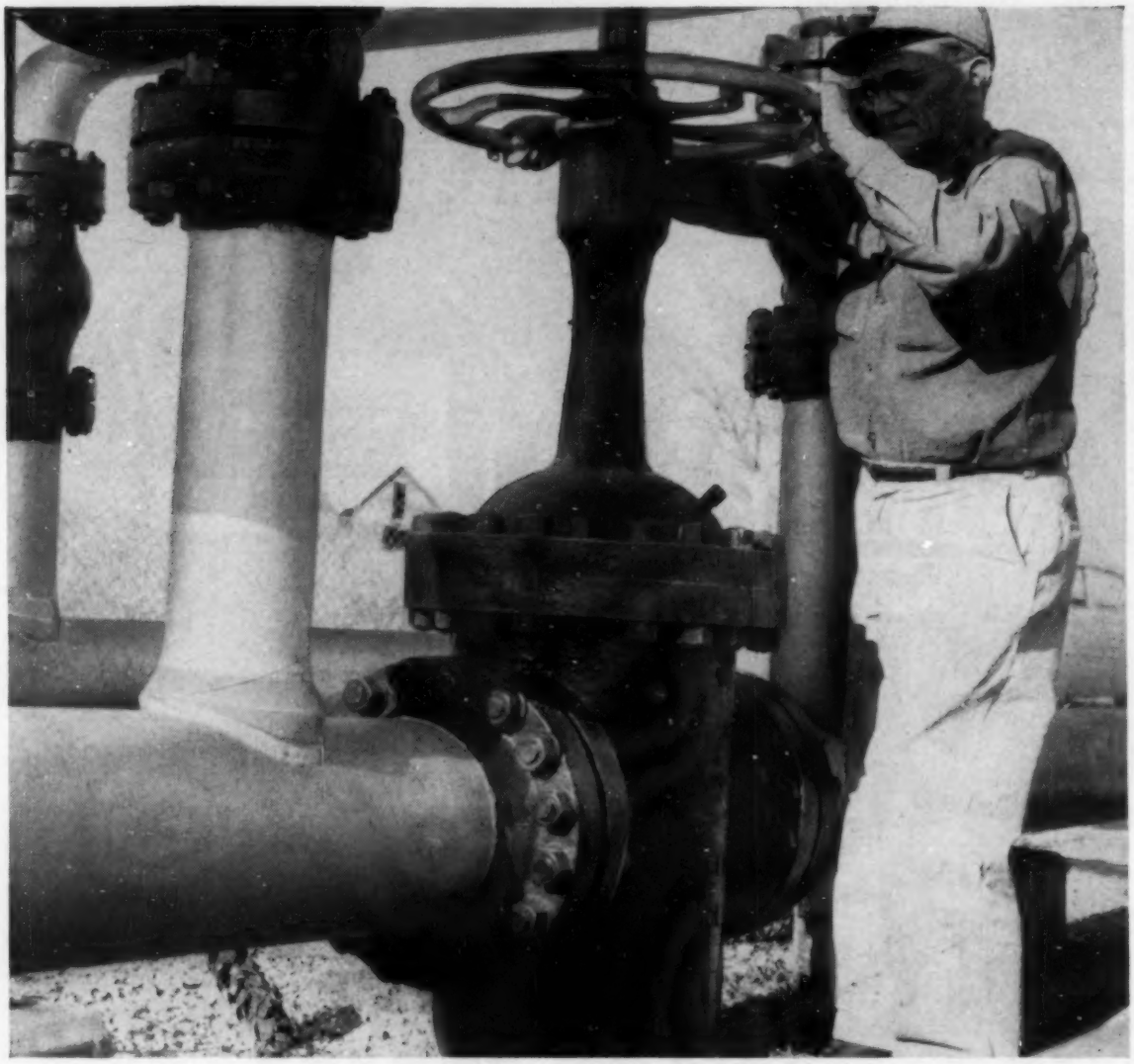


Easy does it...year after year with this Crane pipe-line valve

THE CASE HISTORY—More than 3 years ago the Phillips Pipe Line Co. installed this Crane conduit valve in a junction manifold on its 10-inch crude line to Borger, from Yale Station, Oklahoma. How's it doing?

Operated every day or two until a few months ago, this Crane double-seating, grease-packed valve has always responded smoothly and easily to the handwheel—never sticking. Under former frequent usage as now with infrequent operation, it has never leaked at the bonnet joint or packing chamber—remains tight as new at the seats. This Crane valve—because its pressurized stuffing box eliminates leakage—is clean, unstained.

On gas and oil, these Crane valves are making big savings in operating costs. They're the leading value for pipe line service, and thrifty buyers know it. Crane Co., General Offices, Chicago 5, Illinois. Branches and Wholesalers in all industrial areas.

CLASS 600 STEEL PIPE-LINE GATE VALVES

Grease packing in body and bonnet assures thorough internal lubrication for easy operation. Parallel disc design gives tight closure; eliminates seat leakage. Spring plates in contact with disc faces keep foreign matter out of body. When open, conduit ports through disc give straight-line, unrestricted flow. Full-way or Venturi patterns; sizes 2 to 30 in. Literature sent by mail, or ask your Crane Representative.

CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

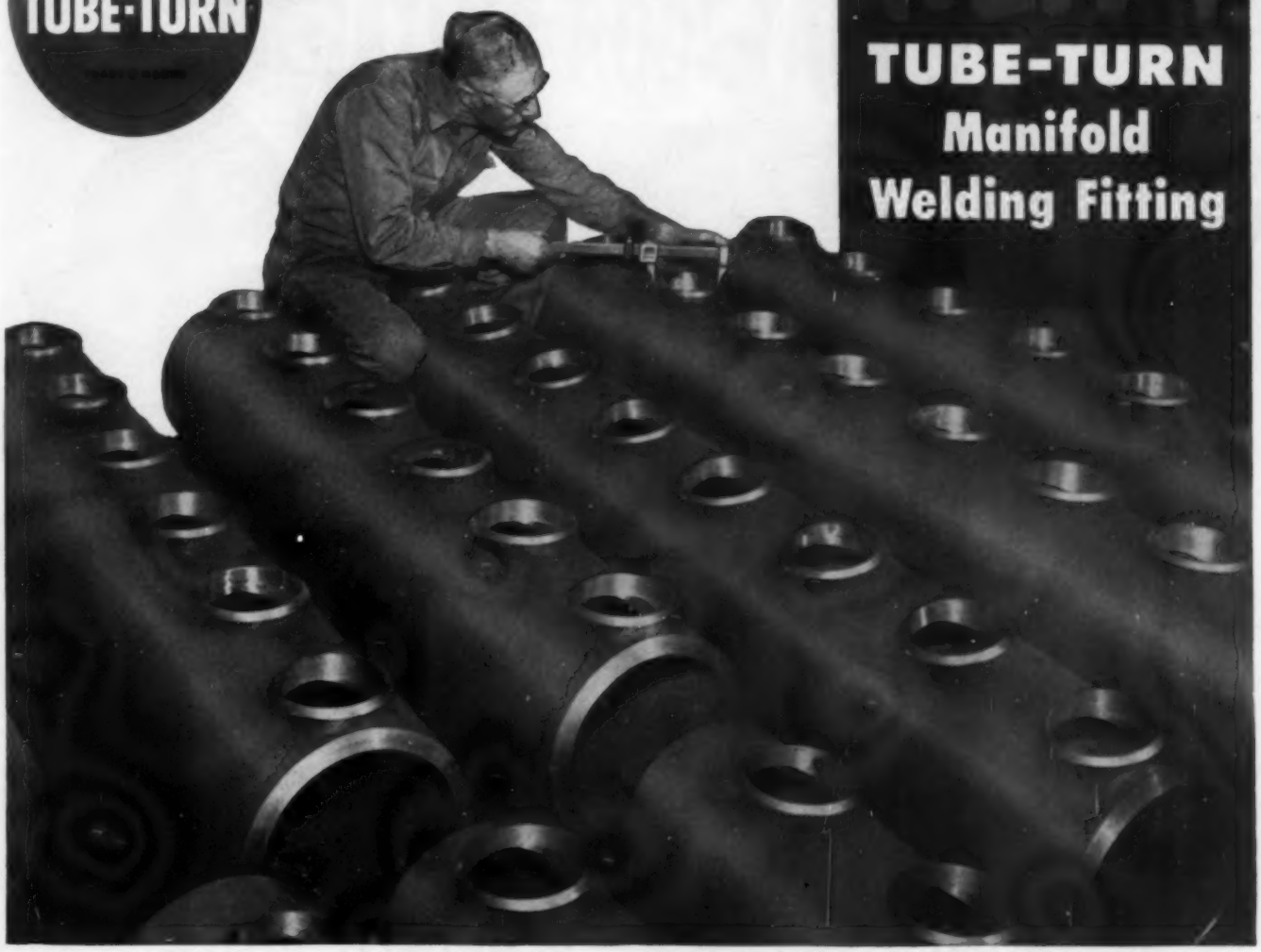
CRANE'S FIRST CENTURY...1855-1955

tt
TUBE-TURN

Remember the trademarks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

NEW!

TUBE-TURN Manifold Welding Fitting

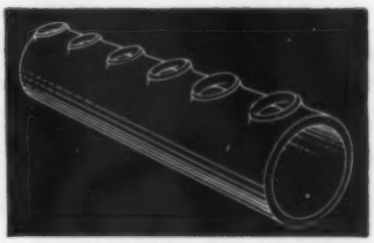


simplifies piping construction, reduces costs

TUBE TURNS now offers custom-made Manifold Welding Fittings with size, wall thickness, and number of outlets as required by your service conditions. These manifold fittings are available in all commercial metals and alloys.

Use of TUBE-TURN* Manifold Welding Fittings provides stronger and safer outlet connections than are possible when pads and saddles are employed. This new fitting makes possible greater economy and speed of construction in many types of service. It is particularly useful when outlets are smaller than one-half the run pipe diameter, when they are extremely close together, or when they must vary in size.

This new addition to Tube Turns' line enables you to "specify TUBE-TURN" for all your tee and manifold fitting requirements. For prompt, helpful service, get in touch with your Tube Turns' Distributor. You'll find one in every principal city.



The new TUBE-TURN Manifold Welding Fitting . . . superior to pad and saddle construction . . . easy to install . . . dependable in service.

TUBE-TURN Welding Fittings and Flanges are made in U.S.A. They meet all U.S. piping code specifications

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

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Personal service—western style

HERE is what Kaiser Steel means to line pipe users in terms of personal service.

It means that you can get immediate, on-the-spot service from our full staff of trained metallurgists, technical men, production men, and sales personnel.

This personal attention to your needs—plus *uniform quality, on-time delivery* and *wide range of sizes*—is another reason why Kaiser Steel can best meet the needs of the area it serves.

Kaiser Steel

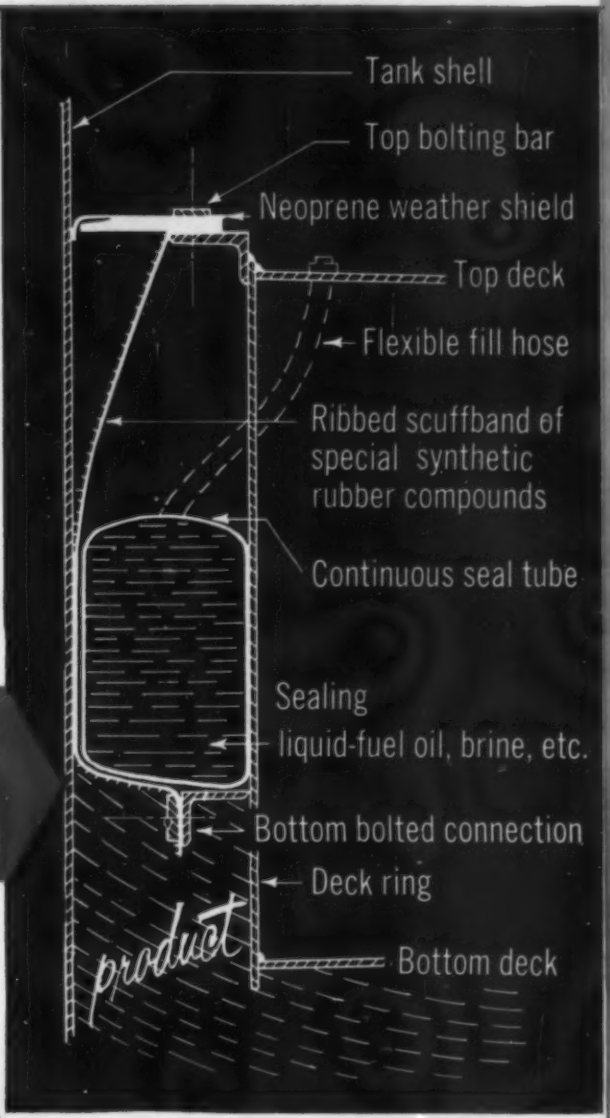
KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Phoenix, Denver, Tulsa, New York

Think of what this means to operators of FLOATING ROOF TANKS!

Elimination of potential vapor-loss and preservation of product quality, the most important reasons for a floating roof tank, are now reality . . . the **HAMMOND TUBESEAL,*** for floating roof tanks of welded or riveted construction, provides the most efficient and positive seal known . . . sealed at a point to prevent vapor space between roof, rim and shell, thus there is no room for vapors to form or for the product to come in contact with outside influences and be contaminated . . . the **TUBESEAL*** has no moving parts, requires no maintenance, adjusts for tank out-of-roundness, is climate proof and non-corrodible, can operate to bottom of tank or above the top . . . **ITS ENTIRE CIRCUMFERENCE IS TIGHTLY SEALED UNDER PRESSURE AT ALL TIMES . . . NO VAPOR SPACE BELOW THE SEAL.**



THERE'S NO ROOM FOR VAPORS TO FORM WITH THE HAMMOND TUBESEAL

THE **HAMMOND TUBESEAL*** HAS BEEN THOROUGHLY TESTED IN COMMERCIAL USE . . . IT IS **GUARANTEED** TO YOUR SATISFACTION.

HAMMOND TUBESEAL* COSTS NO MORE IN THE FIRST PLACE

*Copyright

ask for Bulletin T5

CHEAPER OVER THE YEARS

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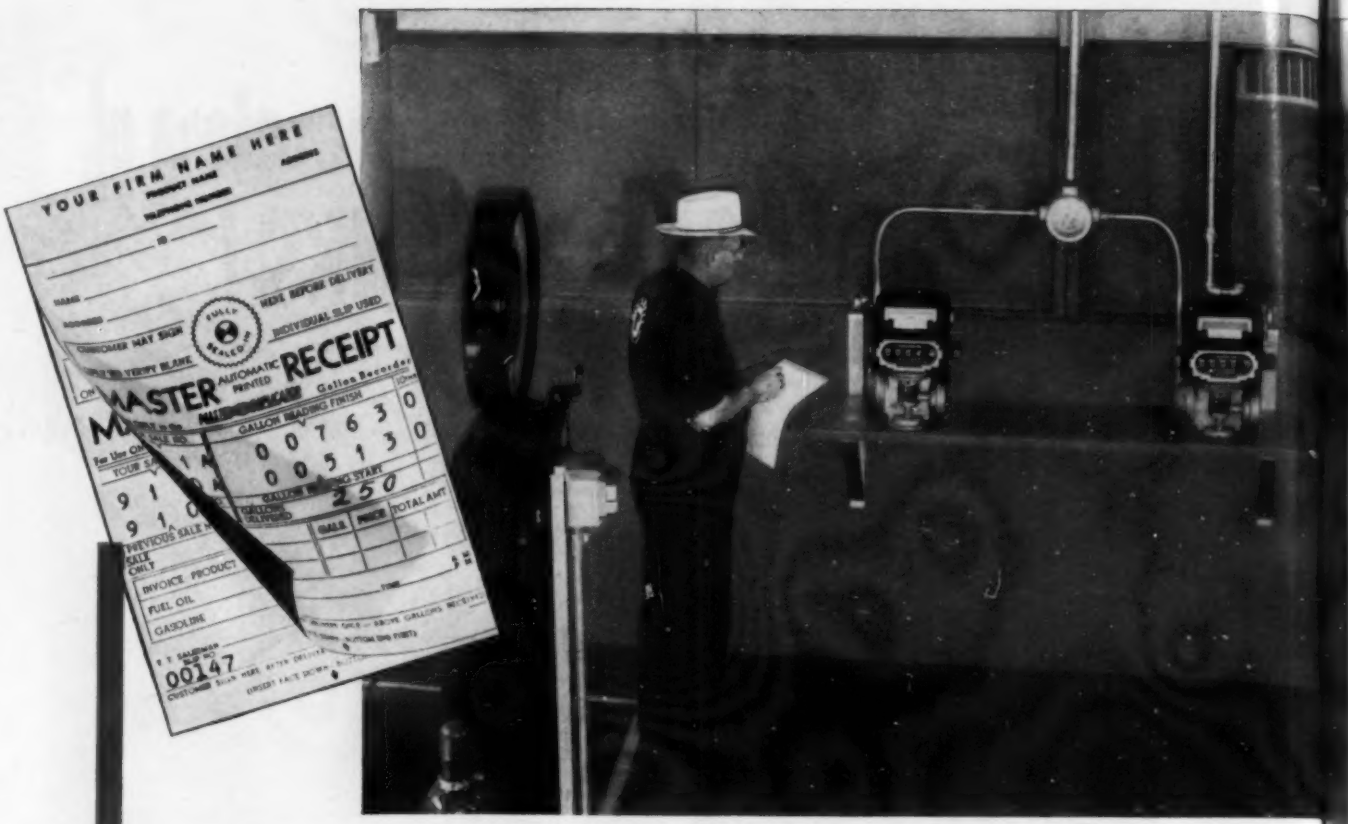


Receiving registers for Rockwell Remote Registration system at indoor proving room of new test station. Inset is replica of multiple carbon tickets as printed by remote registers.

Here's one for the *that aids the auditor*

Rockwell's new test station is the proving controlled accounting systems

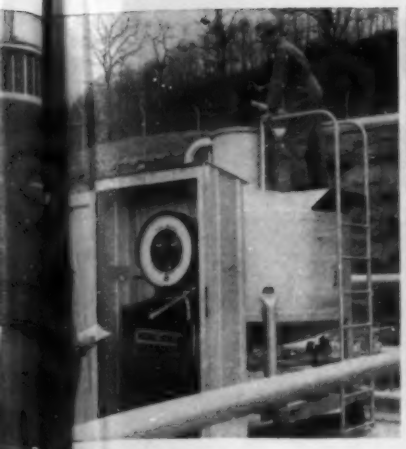
Check and double check Engineer checks performance of 500 gpm Rockwell Rotocycle meter on one of the two 4-in meter runs for gasoline, solvents and fuel oil. Two 6-in. runs are also provided for these fuels.

In This Unique Plant We Develop and Demonstrate Auditing and Accounting Practices That Save Money For Petroleum Distributors.

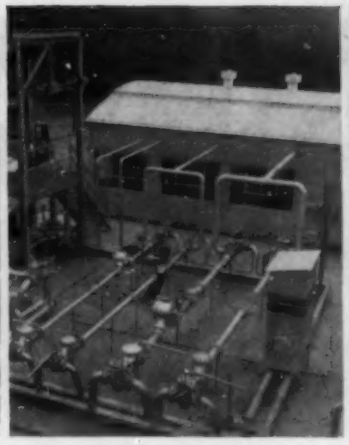
The use of meters as a basic requirement for auditing and accounting has been recognized by the gas and electric utilities for years. This same concept of meter control is becoming increasingly popular with all liquid processors.

In the new Rockwell test station you can see actual demonstrations of metered record keeping systems complete from remotely registered ticket printing right down to log books, delivery receipts and invoicing records. You can see how such mechanized controls cut bookkeeping time and effort, speed dispensing—even provide acceptable records to justify tax deductions on stock transfer losses. Too, you'll see how rigorously we test our meters under actual operating conditions while measuring the same liquids they will handle in the field.

A trip to and through the new Rockwell meter testing station is an eye-opening experience. We invite you to visit it at your convenience.



The proof of the pudding These proving facilities are used to test meters on viscous liquids including Bunker "C" and other industrial fuels at up to 1000 gpm. Heat coils permit testing at various operating temperatures.



Operation Rockwell View of operating floor at test plant with two meter loading rack, at left, fitted for remote registration. Measurement from this rack is transmitted by electric impulse to printing registers inside building.

The only plant of its kind Aerial view of new Rockwell test station containing every facility for petroleum meter proving, accounting, research and development.

book...

ground for meter

Rockwell *ROTOCYCLE* Meters

YOU CAN REALLY ROCKWELL RELY ON ROCKWELL

Remote Registration

improves accounting, cuts stock losses

Transmitter

At every transfer point in petroleum's path to market—at field inlets, pipeline terminals and loading racks—you can use the Rockwell Remote Registration System with profit. The unalterable sealed-in tickets are mechanically printed. Control over all volume dispensed rests in the hands of one responsible person. Losses are quickly curbed, accounting is mechanized. To get full facts, write for bulletin OG-324.

Receiver

ROCKWELL MANUFACTURING COMPANY PITTSBURGH 8, PA.

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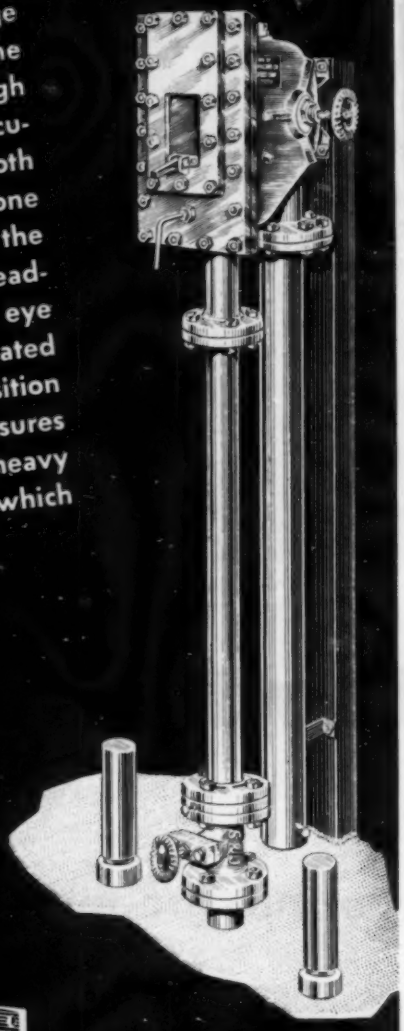
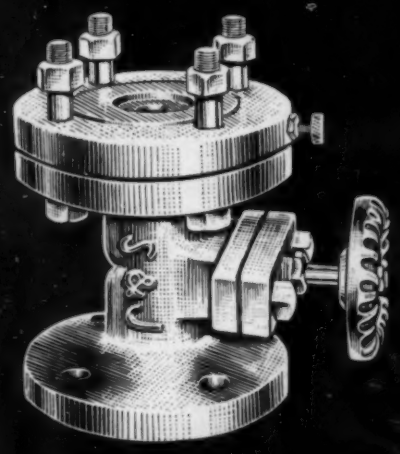
Canadian Gas & Oil Products Sales: Peacock Brothers, Limited

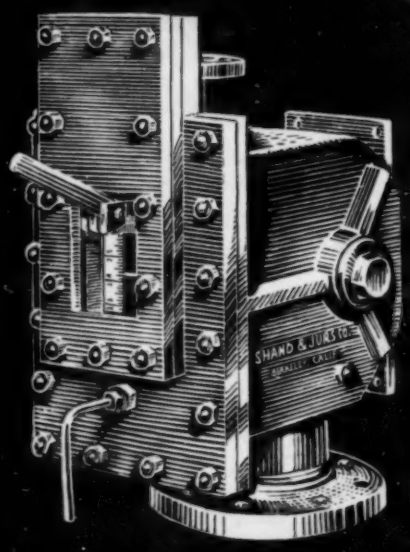
S&J AUTOMATIC GAGES
for Pressure Storage

Since hand gaging of pressure storage vessels is impossible and gage glasses are frequently too inaccurate, automatic tank gaging is the only practical alternative. S. & J. engineers have designed two high pressure automatic tank gages which will consistently and accurately measure product depths in pressure storage vessels. Both gages are similar in operating principle but differ primarily in one important aspect—MOUNTING. Model ST-400 R, illustrated at the right, is designed for mounting on tank tops and for eye level reading. Model ST-400 is designed for ground level installation and eye level reading. In both gages, an 18-8 stainless steel tape, graduated to eighth inches, is affixed to a pressure type float, held in position by guide wires. Both types are available for operation at pressures up to 300 pounds. In both designs, the tape is read through heavy safety glass, which can be kept clear by an inside wiper, and which is protected against breaking by a special steel closure.



The S. & J. Tape Block Valve, Figure ST-5265, passes the reading tape through a heavy synthetic rubber tube. When it is desirable to isolate the gage head from tank pressure, the valve is screwed down to flatten the tube against the tape and provide complete isolation for inspection, maintenance or repair of the reading head.





S. & J. Automatic Tank Gages are available in a great variety of designs, from the most simple, to elaborate electric telepulse remote reading gages. Having pioneered automatic tank gaging, you can look to S. & J. to supply a SAFE and ACCURATE automatic tank gage for every requirement in the petroleum industry. Tell us of your requirements and we will gladly make recommendations covering any gaging problem.

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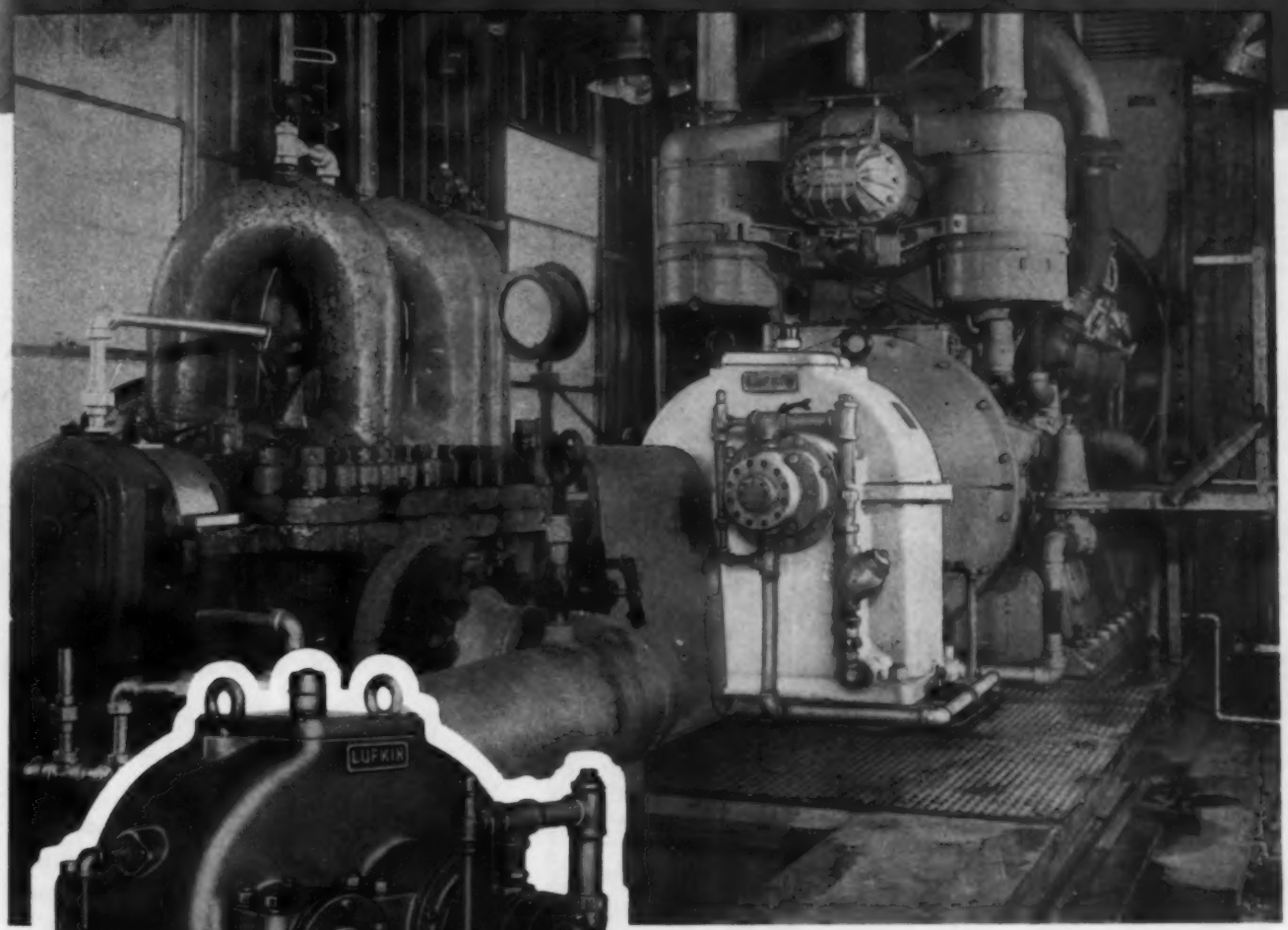
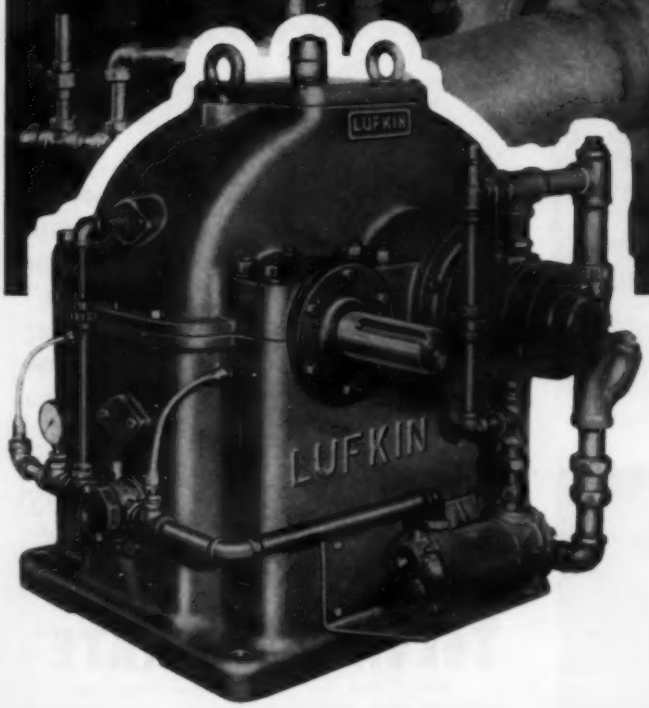
LUFKIN Precision Gears

GUARANTEE THE UNINTERRUPTED TRANSMISSION OF POWER SO NECESSARY FOR THE UNINTERRUPTED TRANSMISSION OF OIL





HERRINGBONE GEARS GENERATED WITH EXTREME ACCURACY—RIGIDLY MOUNTED IN HEAVILY REINFORCED HOUSING—TO GIVE MANY YEARS OF QUIET, VIBRATIONLESS, TROUBLE-FREE OPERATION.

LUFKIN OFFERS A COMPLETE LINE OF SPEED INCREASERS FOR ALL TYPES OF PIPELINE SERVICE.

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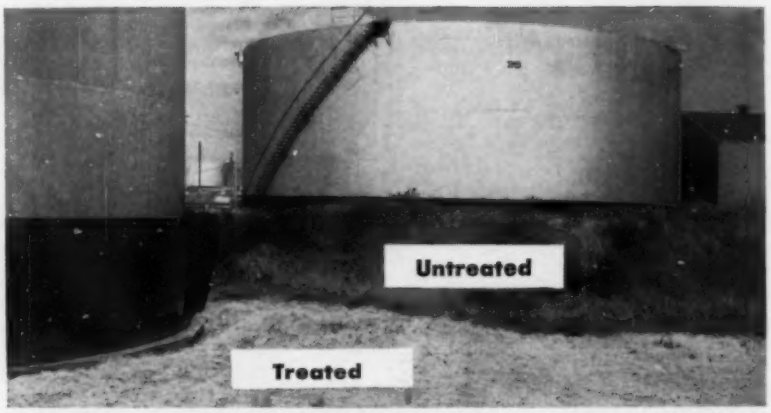
Lufkin equipment in Canada is handled by THE LUFKIN MACHINE CO., LTD., 14321 108th Avenue, EDMONTON, ALBERTA, CANADA

Weed and Brush Control lasts longer with Du Pont TELVAR® and AMMATE®

Weed Killers — *Weed and Brush Killer*



Fire hazards are reduced around oil storages from thorough, long-term weed control with Du Pont "Telvar." "Telvar" is non-corrosive, won't harm application equipment.

Heavy weed growth was controlled with one application of "Telvar." "Telvar" keeps pipelines and key areas accessible, efficient to work around.

"Telvar" is ideal for weed control around derricks, pumps, storages. "Telvar" is easy to apply; extremely low in toxicity to humans and animals; non-flammable; and non-volatile.

One application of "Telvar" solves weed problems for a season or longer!

"Telvar" kills through the roots . . . prevents regrowth. Low dosages (20 to 80 lbs. per acre) make it cost little for the results you obtain. Low rates also mean less handling, less storage facilities. If you're looking for a way to cut maintenance costs to new low levels, include "Telvar" in your weed-control program. Available in two formulations: "Telvar" W; and "Telvar" DW, which is especially suited for light, sandy soils and in areas where annual rainfall is higher than 20 inches.

"Ammate" kills more kinds of brush and keeps it down longer than most weed and brush killers!

When the original spray job is well done, brush is kept under control with nothing more than an occasional spot spray later. You can rely on "Ammate" to do the job safely, even where your rights-of-way adjoin crop land, because "Ammate" is not volatile. There are no vapors to drift onto sensitive crops.

FREE ILLUSTRATED BOOKLETS describe how to control weeds and brush with Du Pont chemicals. For your copies, write to Du Pont, Grasselli Chemicals Dept., Rm. D 4032, Wilmington, Del. In Canada—Du Pont Company of Canada Limited, Box 660, Montreal.

TELVAR® AMMATE®

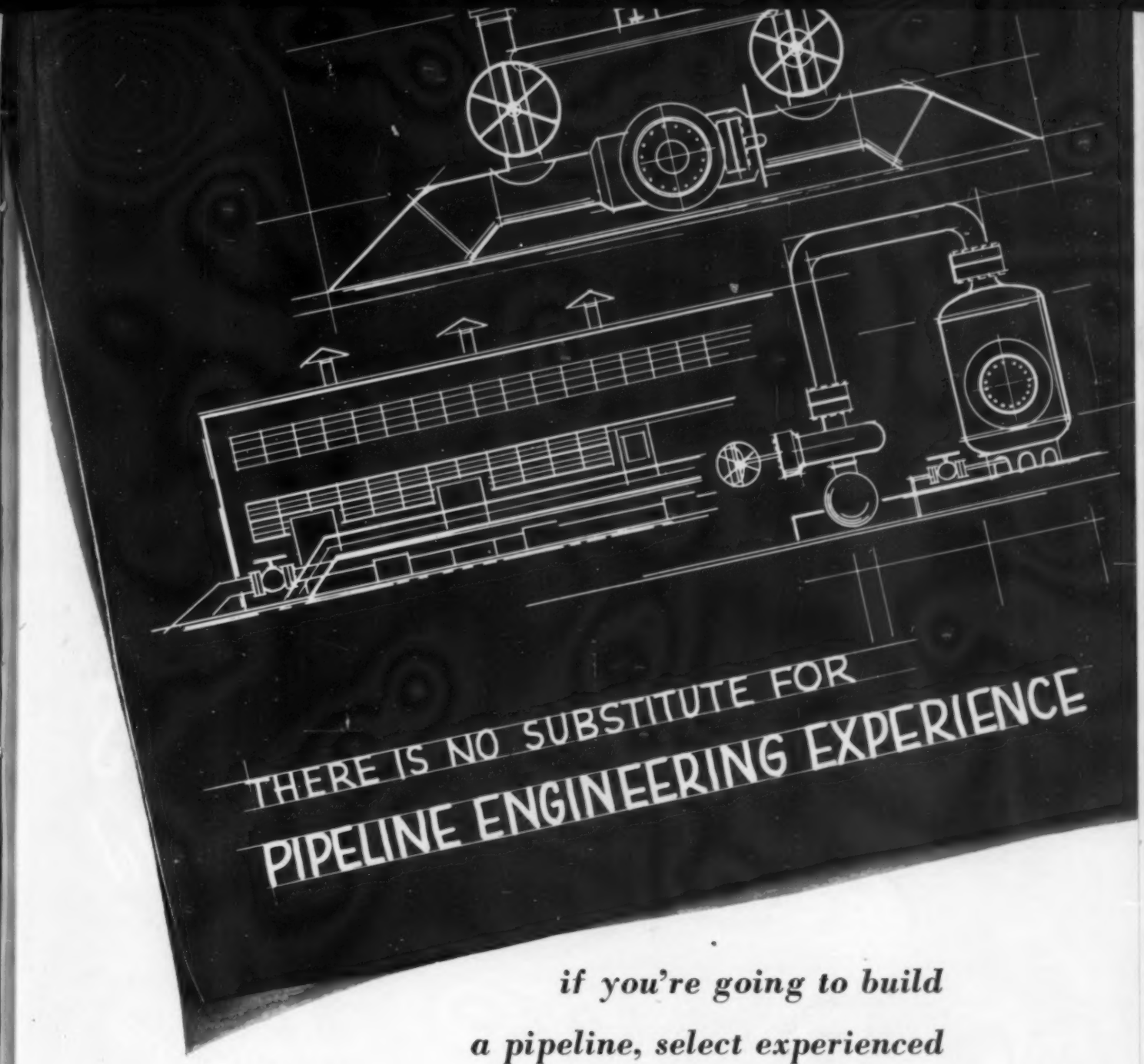
Weed Killers — *Weed and Brush Killer*

On all chemicals always follow directions for application. Where warning or caution statements on use of product are given, read them carefully.

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



if you're going to build
a pipeline, select experienced
pipeline engineers

Gulf Interstate Engineering Company has the experience you need in building oil and gas pipelines. In every phase of design and construction, Gulf Interstate engineers have set an advanced pattern for the pipeline industry.

Your inquiries are invited.

Gulf Interstate Engineering Company

GULF INTERSTATE BUILDING • HOUSTON, TEXAS

SUBMARINE PIPELINES

around the world

COLLINS CONSTRUCTION COMPANY

PORT LAVACA, TEXAS

P. O. Box 256 Cable Address Collinstex Portlavaca (Texas) JAckson 4-3771

Let's get technical about WALWORTH LUBRICATED PLUG VALVES for pipeline service

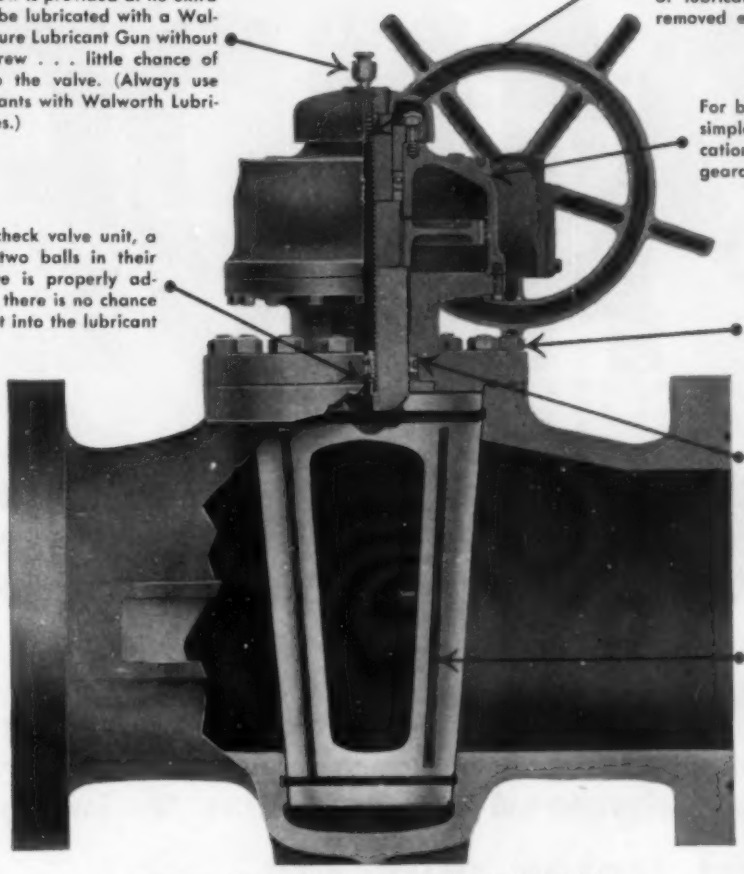
Combination button-head lubricant fitting and lubricant screw is provided at no extra cost. Valves can be lubricated with a Walworth High Pressure Lubricant Gun without removing the screw . . . little chance of grit getting into the valve. (Always use Walworth Lubricants with Walworth Lubricated Plug Valves.)

An added safety feature in the form of a groove cut part way up side of the lubricant-fitting screw allows the operator to observe any tendency of lubricant to blow out before the screw is removed entirely.

For buried pipelines — yoke design permits simple attachment of handwheel and lubrication extensions without modifying the gearcase.

In the stainless steel check valve unit, a transverse pin holds two balls in their seats. When the valve is properly adjusted and lubricated, there is no chance for line pressure to get into the lubricant system.

Standard bolt threads, rather than fine threads, mean easy replacement of nuts and bolts from local stocks.



Cutaway of a 24-inch Walworth Lubricated Plug Valve

Two overlapping Teflon packing rings form an effective seal against possible leakage without "grabbing" the plug shank. Low breakout torque . . . plug turns easier. Packing serves only as a seal and is not used to hold the plug in its seat.

Lubricant grooves completely frame the port openings and encircle the plug at the top and bottom assuring a tight seal against leaks. Bottom circumferential groove is separate from, but connected with, the lubricant well.

Other Walworth Lubricated Plug Valves include Single Gland and Regular Gland types. Sizes to 30 inches. Pressures to 5000 psi. and for vacuum service.

Without exception, a Walworth Ball Bearing Lubricated Plug Valve is easier to operate and maintain than any other type of rotary-action, sealed valve available today for pipeline service. Design features pointed out here show just a few advantages of Walworth Ball Bearing Lubricated Plug Valves.

Many pipeline companies throughout the world use Walworth valves for handling gas, crude, and finished products. Investigate the line of Walworth valves for your own needs. See your Walworth Distributor, or write for literature: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

Use pigs or scrapers?

Walworth Type 49 Cast Steel Gate Valves are designed on the throughport principle to permit passage of pigs and scrapers — may be installed without regard to flow direction. Sizes 2 to 30 inches inclusive. Ask for literature.

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LINE PIPE

With the installation of facilities for hydraulic expansion well under way at the Steelton, Pa., plant, Bethlehem Steel Company will soon be able to furnish an unusually wide range of welded, large-diameter line pipe to the oil and gas industries. We invite your inquiries.

HIGH-TEST LINE PIPE

Cold expanded, electric-fusion-weld line pipe meeting API 5LX specifications, in diameters from 18 in. to 36 in. Available in 40-ft lengths and in wall thicknesses to 5/8 in. Bethlehem is also equipped to coat pipe exteriors and interiors.

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Pipe fabricated from alloy steels such as high-strength, low-alloy Bethlehem Mayari R steel plate (50,000 yield). This pipe is immediately available as rolled in 40-ft lengths and in wall thicknesses as required. All diameters from 18 in.

BETHLEHEM STEEL

For further information about Bethlehem Oil & Gas Pipe, please contact the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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Whether You Pig or Blowdown—

W-K-M Through-Conduit Valves are your safest investment

Though it may be only once, sooner or later you'll want to run a scraper through your line. And if you have to burn out valves with obstructed bores, then and there you've paid more than the difference between W-K-M Through-Conduit Valves and less efficient valves. So you are way ahead if you install W-K-M Through-Conduit Valves today. Not only do you avoid an emergency shut down, but you get performance unequalled by any other valve at any price. There are many more reasons why W-K-M Through-Conduit Valves should be on your mainline. Call your nearest W-K-M sales engineer and ask him to show you the miniature working model which tells all.

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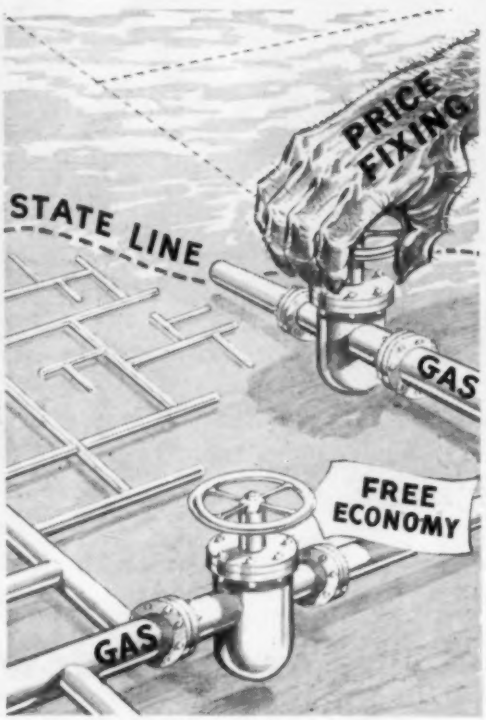

ECONOMISTS of the Empire Trust Company calculated that in the United States, 33,000,000 families cook with gas; 18,000,000 heat water with it; 14,000,000 use it to heat their homes; while 4,000,000 get refrigeration from it. The statistics include all types of gas.

Impressive as they are, they are but an indication of a trend. In the Southwest where it is convenient, 60 per cent of homes use natural gas. In other areas, only 5 per cent of the homes are served with natural gas. The potential is more impressive than the accomplishment.

In just four large cities, 270,000 householders are on lists waiting for natural gas service. This is part of the evidence which justified the prediction that the natural gas industry would have a five-fold expansion between 1950 and 1975. That could be accomplished by providing sufficient transmission systems out of the Southwest, which provides 88 per cent of the nation's natural gas.

The prospect took a different hue when the heavy hand of price fixing came down on the gas producer through the decision of the United States Supreme Court in the Phillips case. Some gas producers immediately cancelled their contracts, which provided for that contingency in the case of federal control. Some state and city officials are now asking the Federal Power Commission to compel continuation of deliveries.

Whatever the outcome of that question, it is certain that some gas producers are not going to make new contracts since, under price fixing, they have no voice in determining the price of their product.

So instead of the home owners of the United States being free to select the fuel they prefer, price fixing by a Government bureau is cutting down the supply of the most efficient fuel—Natural Gas.

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for more power—better performance—longer life...

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ALLIS-CHALMERS

HD-21

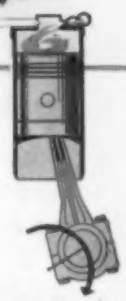
204 net engine hp
44,000 lb

New standards of output The HD-21 introduces the new Allis-Chalmers engine and a great new power team. Together, they provide extra speed with any load, extra pulling power at any speed . . . wider speed ranges and more range overlap. And with its advanced design torque converter (*the result of 15 years of leadership by Allis-Chalmers*) the HD-21 puts its power to work with less shifting than ever before possible . . . to help you reach a new high in efficient, profitable production!

New standards of durability From the new Allis-Chalmers diesel with "follow-through" combustion to new, heavier Tru-Dimension track, the HD-21 is built to take today's big loads in stride, and come back for more. Here are just a few more of the long-life features you can't get from anyone but Allis-Chalmers . . . at any price: all-steel Box-A main frame, straddle-mounted final drive gears, 1,000-hour truck wheel lubrication, oil-enclosed track release mechanism.

New low cost per unit of work The HD-21 offers 20 percent greater over-all performance . . . provides a new measure of tractor value. Add the *planned* approach to service offered by Allis-Chalmers dealers, and it's the ideal team for men tackling today's *big* jobs.

Here's one of the HD-21's many new features—



New Allis-Chalmers engine—
Brings you top performance, extra-long life through a new kind of "*follow through*" combustion. Here's why—

The key explosion occurs in the energy cell as shown, unleashing a blast that sets up cyclone turbulence. Result—no damaging peak pressures . . . instead, higher average working pressures and better leverage on the crankshaft. *Be sure to ask your Allis-Chalmers dealer for the visual story revealing the full advantages of this new engine.*

Nowhere can you match the HD-21 in the amount of work it will do!

ALLIS-CHALMERS

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WITH BUCYRUS-ERIE DRAGSHOVELS

Now you can reach farther, dig deeper and cleaner, and dump faster than ever with a Bucyrus-Erie dragshovel. A new cambered boom and dipper lets you handle trenching easier, faster, and for lower cost.

The heavier boom adds power to the digging stroke, helps dipper penetrate easily even at maximum depth and reach. Not only does the longer boom increase digging reach, but the cambered midsection raises boom clearance to permit digging over the corners of crawlers. Dumping is easier because the dipper raises higher and can be brought closer without spilling the load.

The new dipper has greater slope to the sides for cleaner, quicker dumping. Side cutters have straight cutting edges for easy penetration; the extended lip area provides a longer shelf for heaping higher loads.

Put a Bucyrus-Erie dragshovel to work cutting trenching costs on your next pipeline job. For complete details on the ½-yd. 15-B or the ¾-yd. 22-B dragshovels, see your Bucyrus-Erie distributor. 119E55

BUCYRUS ERIE

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1880 75 1955 YEARS OF SERVICE to Men Who Shape the Earth

WHO'S MEETING WHERE

MAY	
1– 4	Liquefied Petroleum Gas Association, Conrad Hilton Hotel, Chicago.
2– 3	Pacific Coast Gas Association, Transmission Conference, Palm Springs, Calif.
2– 3	Gas Compressor Institute, Legion Hall, Liberal, Kansas, Sponsors—University of Kansas and Southwest Kansas Petroleum Industry.
2– 6	American Gas Association, Industrial Gas School, Hotel William Penn, Pittsburgh.
2-13	British Industries Fair, London and Birmingham, England.
5– 6	Corrosion Short Course, Shreveport Section, National Association of Corrosion Engineers, Centenary College, Shreveport.
9-10	American Gas Association, Gas Supply, Transmission and Storage Conference, Hotel William Penn, Pittsburgh.
11-12	Pacific Coast Gas Association, Gas Supply and Transmission Conference, Technical Session, Palm Springs, Calif.
11-13	Canadian Institute of Mining and Metallurgy, Petroleum and Natural Gas Division, MacDonald Hotel, Edmonton, Alberta.
12-13	Symposium—Automation, Engineering for Tomorrow, Michigan State College, East Lansing, Mich.
16-18	American Petroleum Institute, Division of Transportation, Products Pipe Line Conference, Edgewater Beach Hotel, Chicago.
16-18	Southern Gas Association, New Orleans.
17-19	Pennsylvania Gas Association, Pocono Manor, Penn.
26-27	Kentucky Oil and Gas Association, Lafayette Hotel, Lexington.
26–	American Society for Testing Materials, Chalfonte-Hadden Hall, Atlantic City, N.J.
30–	Chemical Institute of Canada, Quebec City, Que.
JUNE	
1– 3	Annual Short Course in Gas Technology, Texas College of Arts and Industries, Kingsville, Texas.
5– 9	Canadian Gas Association, Annual Meeting, Sheraton Brock, Niagara Falls, Ont.
6– 9	American Society of Mechanical Engineers, Oil and Gas Power Division, Hotel Statler, Wash.
6-15	Fourth World Petroleum Congress, Rome, Italy.
7– 9	Mid-West Gas Association, Gas School and Conference, Iowa State College, Ames.
7-10	American Welding Society, Hotel Muehlebach, Kansas City.
9-10	Natural Gas and Petroleum Association of Canada, Royal Connaught Hotel, Hamilton, Ont.
11-15	Petroleum Equipment Suppliers Assn., Banff Springs Hotel, Banff, Alberta.
13-17	American Society of Civil Engineers, Committee on Pipelines, St. Louis.
20-23	American Society of Mechanical Engineers, Semi-Annual Meeting, Hotel Statler, Boston.
23-26	Rocky Mountain Oil Show, Casper, Wyo.
26–July 1	American Society for Testing Materials, Chalfonte-Hadden Hall, Atlantic City.
27-28	Michigan Gas Association, Mackinac Island, Mich.
AUG.	
29-31	Appalachian Gas Measurement Short Course, West Virginia University, Morgantown.
SEPT.	
11-13	Independent Natural Gas Association of America, Jasper Park Lodge, Jasper, Alberta.
12-16	Instrument Society of America, Conference and Exhibit, Los Angeles.
13-24	International Instrument Congress and Exposition, Philadelphia.
14-16	National Petroleum Association, Annual Meeting, Traymore Hotel, Atlantic City, N.J.
27-30	International Gas Union Conference, Hotel New Yorker, New York.

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ROSKOTE PAYS

Whether applied by Roskoter* (top), brush (bottom) or spray, Roskote *cold-applied* mastic's drying speed and handling ease cut manhours from work schedules. Yet it costs only three cents per square foot of coverage.

Roskote dries to the touch in 20 minutes and is ready for backfill in an hour. It bonds readily to previous coatings of coal tar or asphalt and is *non-toxic.*

This tough, natural resin-base mastic sets to a flexible film without brittleness or sag through a temperature range of —40°F to 375°F . . . withstands the pressure, strain and abrasion of the meanest soils. Roskote alone has an electrical resistivity of 20 megohms per sq. ft. and is highly resistant to the corrosive attack of acids, alkalies, salts and moisture.

Find out for yourself why over 100 major utilities and pipeline companies specify Roskote for their "tough" jobs. Write for complete technical information and free sample, and while you're at it ask about application by Roskoter, Royston's revolutionary new coating device.

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ROSKOTE

IN ANCIENT ROME, life expectancy was 23 years at birth. A century ago, an American over 40 was living on borrowed time. In 1950, the average life span of an American was 68 plus. Where does the mandatory retirement age fit into this pattern of lengthening usefulness?

A New Look at Retirement

Ability cannot be measured by age alone. Many healthy men over 50 will outproduce their juniors. So why retire them?

By IRVING LADIMER

SOME WEAR OUT, some rust out and some are forced out!

This stark summary of use and age applies to men no less than machines. But management has sometimes given less eye and ear to the men than to the machines with which they produce, transport and refine.

In the oil industry, which has a heavy stake in equipment and tools, the wary operator knows the value of full use of his material investment. He knows that rust, scale, obsolescence and neglect slim margins, cut profits. He sees to it that his working inventory is kept trim and up-to-date. He stresses flexibility and new uses for his light and heavy gear and tries to get the most out of it right up to the minute it's slated for the scrap pile.

Men Versus Machines—When mechanical factors are favored over human factors, industry gets poor labor return and falls short in commanding worker loyalty and respect. In tight labor periods, some management has also fallen short in production, because it has not had the vision to consider human needs and earn staff support.

—Not This

- Myths About Older Workers
  - Older workers are crabby
  - Older workers can't take supervision
  - Older workers can't learn
  - Older workers are inflexible
  - Older workers are not ambitious

(These are unestablished stereotypes disclosed by Dr. Irving Longe, Columbia University psychologist, based on interviews with workers and employers).

—But This!

- Older Workers Perform Well —But Differently
  - They stress accuracy over speed
  - Differences in individual performance increases with age
  - Industrial skills can be maintained at older ages than when *learned* under present training methods
  - Older people are more content and efficient in small work groups

(Based on laboratory studies reported by New York State Joint Legislative Committee on Problems of Aging).

The company which has gone beyond the legal requirements of workmen's compensation, old age and unemployment benefits and sick pay (in some states), has generally fared better in getting and holding a work force and in capturing community esteem. Attention has been given to safety, to recreation and welfare, to health exams and, lately, to utilization of older workers and guiding them into fruitful retirement. These fringes pay off in higher morale, employe pride, and security and family interest. For the company, it multiplies income directly in higher and better production; indirectly through less sickness absenteeism, reduced turnover, abbreviated training costs, and—not to be overlooked—lower retired pay and other costs of benefits due *after the job*. Instead, he gets work *on the job* from experienced, satisfied help.

It is important to have a complete employe program, especially when rival employers and rival industries, in today's market, compete lustily with such inducements. Stopping at third base adds no more to the score than striking out. You've got to bat the runner home. Or at least try.

Old But Not Out—When the Census Bureau recently changed its big register announcing a U. S. population of 160 million, many envisioned a smiling airborne stork carrying another bundle from heaven. True, of course, but the peak population figure owes its existence as much to continuing lives and fewer deaths as to new lives.

The number of people in this country has doubled in the last 50 years. The number of middle aged (45-64) has tripled and the oldsters (65 and over) has quadrupled. Today there are about 35 million at the half-century mark; and over 13 million are 65 or past, and this group is growing about 400,000 a year. One in every 12 is 65 or older.

How does this happen? Even though births are now on the increase, life expectancy and good health have generally advanced more steadily and markedly. Many childhood and infectious diseases have been licked. More of us are putting off the undertaker and many of us are living longer. In ancient Rome, life expectancy was 23 years at birth. A century ago, an American over 40 was living on borrowed time. In 1900, you were past the average at 48 years. In 1950, the average lifetime of the American peo-

Suggested Pattern For Your Program

1. Recruit older workers for suitable jobs
   Determine where they can be used by analyzing jobs now filled by older workers; studying job requirements; company production, medical, turnover, absence records.
2. Maintain older worker efficiency
   Adjust hours, work schedules, physical conditions (light, heat, noise). Provide proper facilities and tools. Give health examinations and advice. Offer personal counseling on aging problems: health, money matters, psychological adjustments, using individual and group techniques.
3. Reassign jobs
   Determine objectively when production declines and examine interest and capabilities for other work. Transfer instead of demote or downgrade by careful preparation and appeal to worker understanding. Use teamwork and group approach; don't single out individual workers.
4. Prepare for Retirement
   Basic educational program. Follow up special areas of interest and individual questions. Encourage further study by those desiring help or are stimulated by group discussion. Use outside specialists to cover particular subjects and lend authority to the guidance.
5. Retirement Policy
   Compare mandatory and elective age practices. Consider a "selective" process based on age, ability, objective tests, interest and financial status. Consider employe committee devices as a recommending group for voluntary retirement.
6. Post-Retirement
   Integrate the ex-employe into the company family by newsletter, service clubs, visiting programs, company facilities and retiring preference.

(Based on "Effective Use of the Older Worker" by Elizabeth Breckinridge, Chapter 13).

When we consider that by 1980, $28.8 billion for pensions of $100 a month might be paid to an estimated 24 million persons over 65 for *not working*, budget-balancing becomes a national nightmare.

ple reached a new high of 68 plus—a gain of 21 years since 1900. Whether, as Professor Pitkin wrote in "Life Begins at Forty," babies born now will live past the century mark hale, hardy and zestful remains to be seen. But not by us. We can easily see, however, that our population is older. Workers can stay on the job longer and can live longer afterwards.

The Issue We Face—This lengthening march of oldsters raises a cloud of gloom or outlines a new horizon of hope and possibility. When we consider that by 1980, $28.8 billion for pensions of $100 a month might be paid to an estimated 24 million persons over 65 for not working, budget balancing becomes a national nightmare. Support of nonproductive people—our children, the sick and disabled and the aged, if not employed—must come out of national production. In the long run, there must be direct aid or government benefits supported by taxes. The dollar drain can be somewhat reduced by keeping older workers on the job and by preparing them for reasonably independent living afterwards. A potential increase of at least 600,000 in the labor force is possible today by utilizing older workers capable of working under proper conditions. Industry must find a way to adjust jobs to meet their abilities.

Problems or Potentials?—The main questions raised by an aging labor force are: opportunities for effective contribution on the job and preparation for a useful after-work lifetime.

Judged by its interest in employe welfare, petroleum is well ahead of most American industry in accomplishment and potentiality. According to an impartial government study, oil industry "benefits in the event of death, sickness and accident, and old age . . . are of special significance because they are illustrative of the rather comprehensive employe-benefit programs developed over the years by firms that have given a great deal of attention to the problem involved." And this is not just a recent or passing interest. Standard Oil Company (New Jersey) has a program 50 years old.

Practically all plans are sponsored and run by the companies. However, almost all are jointly supported, at least in part, by employer and employe contributions. This pattern contrasts sharply with the usual industrial plan, conceived and pressured into being under wartime stabilization and collective bargaining. Without comparing individual benefits and total programs, it is clear that oil has demonstrated a longer, better established and less opportunistic concern for these fringe conditions. On this basis, as well as its respected employment standards, oil can also pioneer in the subtler yet more meaningful programs of utilizing older workers and schooling them for a satisfying old age.

The oil industry has an impressive head start—a solid industry, a tradition of employe welfare, and future prospects unlimited in a nation built on, and built for, power. The conditions and opportunities are ripe for improving further and where it

Population of the United States, by Age and Sex: 1900 to 1950
(Percentages based on rounded figures. Figures for 1900 to 1930 adjusted to include persons of unknown age)

AGE	NUMBER (in millions)						Percent Increase 1900–1950	PERCENT DISTRIBUTION					
	1900	1910	1920	1930	1940	1950		1900	1910	1920	1930	1940	1950
Total, All Ages	76.0	92.0	105.7	122.8	131.7	150.7	98	100.0	100.0	100.0	100.0	100.0	100.0
Under 10 Years	18.1	20.4	23.0	24.1	21.3	29.4	62	23.8	22.2	21.8	19.6	16.2	19.5
10 to 19 Years	15.7	18.2	20.1	23.6	24.1	21.7	38	20.7	19.8	19.0	19.2	18.3	14.4
20 to 34 Years	19.8	24.2	26.5	29.9	32.9	35.2	81	25.6	26.4	25.1	24.3	25.0	23.4
35 to 44 Years	9.2	11.7	14.2	17.2	18.3	21.5	134	12.1	12.7	13.4	14.0	13.9	14.3
45 to 54 Years	6.4	8.4	10.5	13.0	15.5	17.3	170	8.4	9.1	9.9	10.6	11.8	11.5
55 to 64 Years	4.0	5.1	6.5	8.4	10.5	13.3	232	5.3	5.5	6.2	6.9	8.0	8.8
65 and Over	3.1	4.0	4.9	6.6	9.0	12.3	297	4.1	4.3	4.6	5.4	6.8	8.1

Source: Adapted by the Bureau of Labor Statistics from U. S. Bureau of the Census. *U. S. Census of Population: 1950*, Vol. II *Characteristics of the Population*, Part I, United States Summary.

counts most: with the experienced, loyal worker who is prepared and anxious to serve as long as he can, given the chance, and who will reflect credit on the company once he leaves.

Tailor the Plan—The keystone of any program for keeping workers steadily, or at least effectively, on the job and training them for life after the job is to gear the plan into the regular company environment. New ideas, modern methods and latest findings should be considered, but *applied* and *adapted* to company traditions and policies. That's why the facts and figures on the industry's experience and attitude toward employe benefits has meaning, why the character of the labor force was studied and its record of employment and wages. Without this background, there would be no point at which to start and, worse, no point of return.

Since the industry has fair wages, a good network of welfare plans and a steady work group with family interests, we can reasonably consider personnel utilization and worker retirement. Otherwise, on the simple formula of first-things-first, the industry would do well (and individual companies should study their standing) to institute cash and service benefits, better working conditions and health and safety programs.

Work versus Retirement—The issue that rises to the top in this crucible of problems on the older worker is fixed versus flexible retirement. Traditionally, where pension systems existed a compulsory quitting age was set. Why? It was argued that such a rule forced workers to prepare; that it insured relatively steady promotion for younger men; that it permitted more accurate labor cost accounting; that it ruled out favoritism and finally, that this certainly was desired and deserved.

Many of these arguments, in particular situations, are valid, but are probably invalid when applied unconditionally. They wrongly assume that chronological age is a proper measure of ability, that people do in fact plan against a certain eventuality, that we have a static rather than dynamic and expanding economy and, worst error of all, that people prefer not to work.

Many firms are re-examining mandatory retirement policies in light of scientifically proven facts that older men are capable of learning new techniques and are definitely more reliable and punctual. Their experience and training often more than outmatch physical strength and endurance. Also, economic studies have established that age makes no difference in desire to work, to keep active and to contribute when, if well, men over 60 and 65 generally outproduce their juniors. And many who have health handicaps can continue effectively in lighter work, at shorter hours, under adjusted work conditions and, underscore this, with sympathetic management.

Learn Before Leaving—Assuming management through its democratic processes has worked out means for profitable use of senior employes through work scheduling, retraining, transfer and adjustment for handicap with fair wage scales, there still remains the job of preparing for the eventual leaving. Whether retirement is must or maybe at a certain age, there will be a severance. According to the current life tables, a man at 50 has 23 years ahead of him, at 60 about 16 years and at 65, about 13. At 70, he can on the average look forward to another decade. For women, these expectancies are even greater.

A study of plans designed to anticipate retirement properly undertaken by the Executive Secretary of the Illinois Committee on Aging (1952), discovered that interested companies want to know: When to begin such a program, how, what should it cover, should it be separate, what responsibility should the personnel, medical or other department take, and, how can acceptance be obtained.

Obviously, there are no set rules, but the familiar principle of erecting new structures on well-established foundations still holds. Preferably, the concept of planning should begin when the employe enters—he should at least be advised that the medical, safety, employe benefit and counseling programs have been united so that he may rise within the company and, upon release, will be prepared for a rewarding retirement.

How? Companies have used preretirement interviewing, individual counseling, group lectures and discussions, global education, house organ articles and global articles distributed through the usual channels.

Expectation of Life and Mortality Rates United States, 1950

Age Years	Expectation of Life In Years	Mortality Rate Per 1000
	Total Persons	Total Persons
At Birth	68.4	29.2
10	61.0	.5
20	51.5	1.3
30	42.2	1.8
40	33.1	3.6
50	24.7	8.7
55	20.9	13.0
60	17.3	19.6
61	16.7	21.2
62	16.0	22.9
63	15.4	24.5
64	14.7	26.2
65	14.1	27.9
69	11.8	38.0

Source: Statistical Bureau of the Metropolitan Life Insurance Company from the abridged life table prepared by the National Office of Vital Statistics, Department of Health, Education and Welfare.

Many firms deliberately abstain from too specific or individual consultation. They feel "there is a definite limit to corporate participation in personal matters." The company helps, advises on request and provides general information. Again, the method should be suited to the techniques found effective for other communication. It is unwise to single out the older worker problem, emphasizing its importance to the possible detriment of other matters.

What? Socony-Vacuum Oil Company, which has considerable experience, covers these subjects in its preretirement interviews and discussions:

Employe benefits: Sick leave, insurance, disability and annuity policies as applied to the individual.

Medical findings and advice as to current work and future care.

Determination of personal interests and hobbies to suggest later opportunities.

Plans for retirement, including financial needs, living costs, proposed activities in the community and other later life problems.

Understandably, personal and family relationships are generally not discussed. General information is afforded and arrangements may be made for specialist aid, depending on the company view of its employe program.

After Retirement—Some firms continue interest in employes after they leave. Marshall Field, Chicago department store, follows the practice of retire and rehire, calling back pensioned workers for one or two months work a year in rush seasons. Production plants engaged in seasonal work try to maintain contact with retired workers to insure a labor reserve when needed.

Almost all companies with established employe communication programs keep pensioners on the list to receive house organs, invitations to company picnics and affairs and even extend regular employe privileges and discounts to ex-employes.

Trends—The rapid rise in interest suggests that the wide-awake company must consider broadly its employe relations program. Give special, but not exclusive, attention to maintaining older workers to the mutual benefit of employer and employe; give further attention to preparing employes, through careful guidance, for their after-work lifetime.

Companies which have adopted plans have testified that they pay off in increased profit, in satisfied work force, in better community relations.

—The End

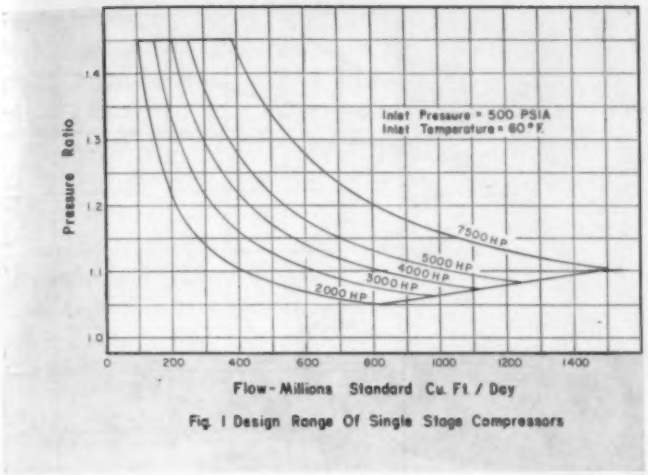

Fig. 1 Design Range Of Single Stage Compressors

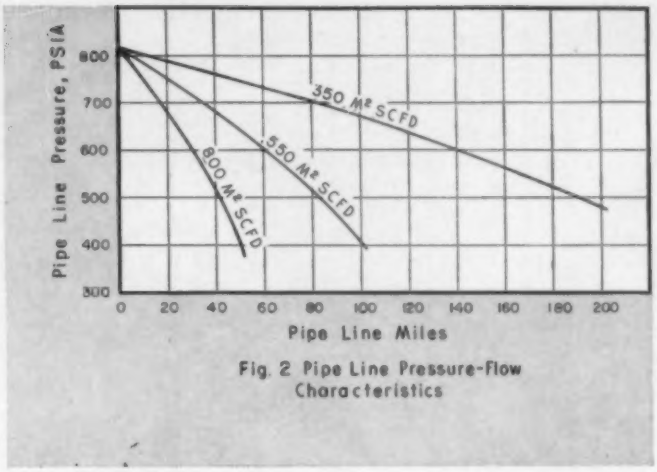

Fig. 2 Pipe Line Pressure-Flow Characteristics

Tailoring Centrifugal Compressors For Use on Today's Gas Pipe Lines

A 'natural' for modern gas pipe lines, the centrifugal compressor is reliable, efficient, and easy to operate and maintain. These design pointers should be of value to both engineers and operators.

By C. F. KOENIG and **L. J. HOLVECK**
De Laval Steam Turbine Company, Trenton, N. J.

A PIPE LINE using centrifugal compressors exclusively may be the next major advance in the pipe line art, and methods of properly "tailoring" the compressors for this service must be thoroughly developed.

A pipe line must be designed to carry varying loads in all kinds of weather. It must handle, for the first few years, probably only a fraction of its ultimate capacity. And it must not falter too badly if some of its machinery breaks down on occasion. All these "musts," when carefully analyzed, spell out quite specific requirements for the gas compressors which move the gas through the pipe line. It is very important that the compressor designer understand all of these pipe line requirements and it is equally important that the pipe line designer understand the capabilities of the compressor he selects.

Centrifugal compressors can be designed for many different pumping requirements and, once designed, will handle off-design operation through a wide range of conditions. However, to insure maximum flexibility and economy of operation, it is essential that the known capabilities of the compressor and the predictable requirements of the pipe line be carefully matched.

Single-stage centrifugal compressors can be built for pressure ratios from 1.05 to 1.50, for flows from 100 to 1500 M²SCFD (million standard cubic feet per day) and for horsepower ratings from a few hundred to 15,000 or more. Higher pressure ratios may be readily obtained by multistaging; either by using more than one impeller in a single compressor or by connecting a number of single stage compressors in series.

Figure 1 shows the range of horsepowers, flows and pressure ratios within which modern centrifugal compressors may be designed to operate. Current operating pressures are from 500 to 1000 pounds per square inch, although higher pressures are being considered and can be handled with little difficulty. Shaft speeds may range from about 3000 to 10000 revolutions per minute, depending on the size of the compressor. Drivers may be electric motors, steam turbines, gas turbines or gas engines.

For most main line booster applications to date where centrifugal compressors have been used, the single stage machine has been selected. These compressors, each with driver, are installed in series in the station. Piping is arranged so that any combination of compressors may be put on the line as the load demands. Spare units may be provided, depending on the load factor of the pipe line.

Pressure-flow characteristics for a typical pipe line are shown in Figure 2. Such characteristics are determined by well known equations for pipe line flow or, more easily, by the slide rule designed by T. R. Rhea. The pressure ratio and horsepower required for centrifugal compressors to raise the pressure up to the starting pressure at any point along the line are

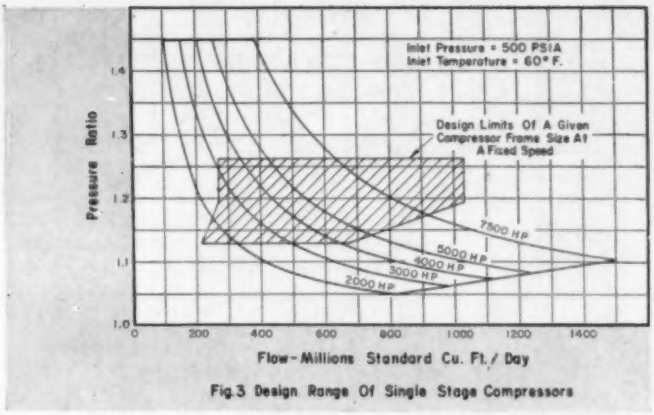
Inlet Pressure = 500 PSIA
Inlet Temperature = 60° F.
Design Limits Of A Given Compressor Frame Size At A Fixed Speed
7500 HP
5000 HP
4000 HP
3000 HP
2000 HP
Pressure Ratio
Flow-Millions Standard Cu. Ft. / Day

Fig. 3 Design Range Of Single Stage Compressors

shown in Figure 4. The actual volume of gas in cubic feet per minutes (CFM) is also shown to facilitate later discussion of the compressor characteristics. Finally, assuming a unit driver horsepower of 5000, single unit stations have been spotted at 130 mile spacing for the initial condition of 350 M²SCFD, two-unit stations at 65-mile spacing for the intermediate condition of 550 M²SCFD, and three-unit stations at 32.5 mile spacing for the ultimate condition of 800 M²SCFD.

Pressures, horsepowers and station spacings which will be involved for each growth step of the pipe line are shown in Figures 2 and 4. Attention must now be directed to selecting the compressors.

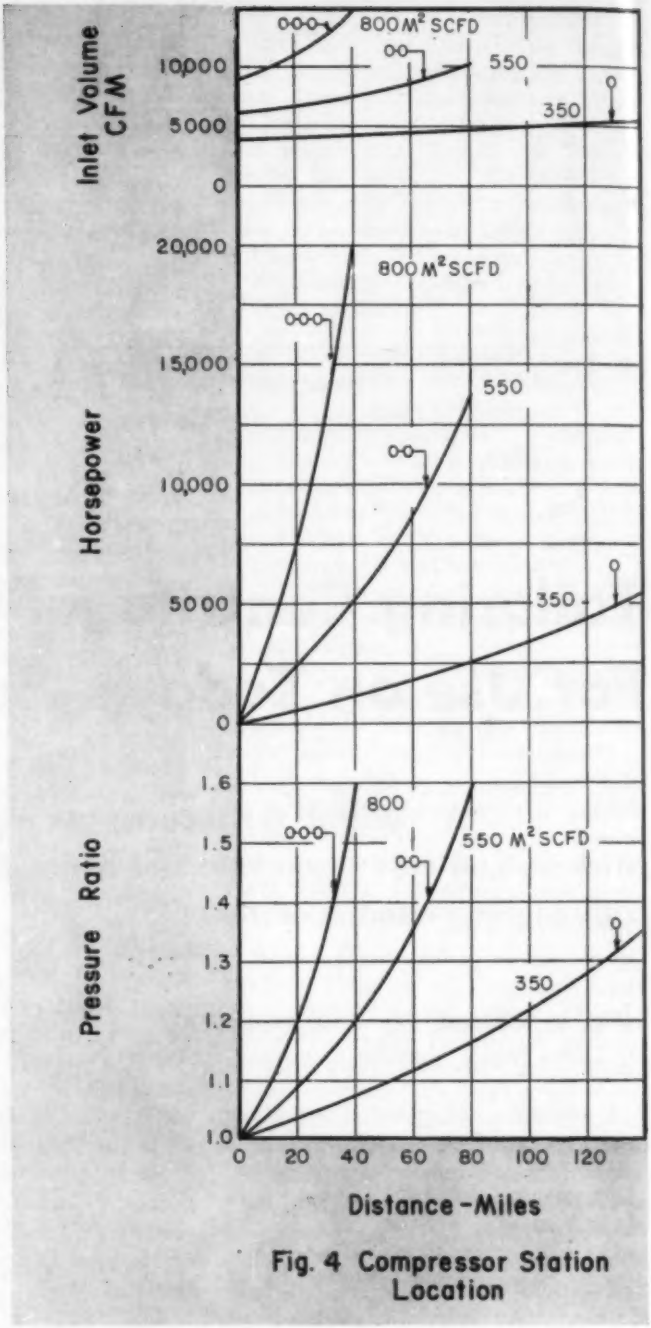

Fig. 4 Compressor Station Location

Design for ultimate load. Compressors should be designed for the ultimate requirements, but smaller capacity "innards," usually impellers, diffusers, and adjacent minor parts, may be necessary for early, low-capacity operation of the pipe line. When flow is increased to design value these small capacity impellers and diffusers may be replaced by those for the ultimate design. Most of the compressor —casing, shaft, bearings, seals, supporting structure, oil system, accessories, and controls—remains unchanged from the initial installation.

Through proper selection of the compressor size and speed it is usually possible to accommodate a growth in pipe line load of the order of two to one by changing impeller and diffuser. When flow is low, a small capacity, large diameter impeller which delivers a high pressure ratio is used. Greater flow requires substitution of a large capacity, smaller diameter impellers for lower pressure ratios. Additional compressors are then installed. The lower flow limit is determined by diameter limitations of the impeller, and also by performance which deteriorates at very low design flows. Typical design limits for a given compressor frame size under average pipe line conditions are shown in Figure 3.

Translate performance to pipe line language. A compressor designer usually prefers to describe performance in terms of actual inlet volume, head (work per pound of gas pumped) and efficiency. Pipe line calculations, however, are based on flow in standard cubic feet, pressure ratio, and horsepower. Some manipulation is necessary in order to obtain compressor characteristics which are readily usuable in application studies. Of many possible "systems" for relating compressor performance to pipe line performance, it is believed that the one illustrated here provides quickly the essential information needed for studying all possible conditions of operation of the pipe line and requires the least amount of incidental arithmetic.

Design points of the pipe line, the station spacing, and the installed horsepower have been established as shown in Fig. 4. Pipe line flow characteristics have been prepared for 32.5, 65, 97.5, 130 and 260-mile sta-

tion spacing, as shown in Figures 5, 6, 7, 8 and 9. These curves show station suction pressure, station pressure ratio, and actual inlet volume versus flow in standard cubic feet for several discharge pressures from the preceding station.

Referring to Figure 4 and also to the indicated pipe line design points in Figures 5, 6 and 8, the compressor requirements may be tabulated for the design points of the pipe line:

CONDITION	Initial	Intermediate	Ultimate
Flow, M²SCFD	350	550	800
Station Spacing, mile	130	65	32.5
No. Units per Station	1	2	3
Overall Station Pressure Ratio	1.315	1.390	1.395
Total Station Horsepower	4900	9650	14150
Station Inlet Volume, CFM	5300	8830	12900

Flows and pressure ratios required of the compressors for the three conditions vary sufficiently that different impellers and diffusers will be necessary for each condition.

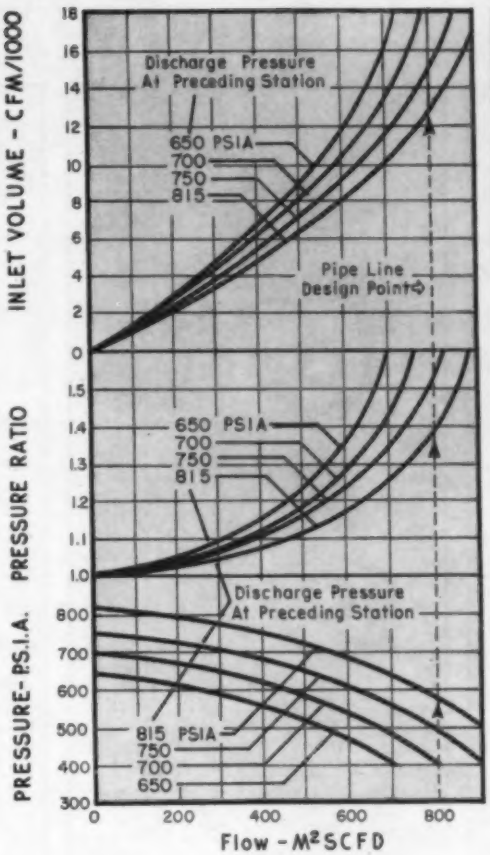

Fig. 5 32.5 Mile Station Spacing

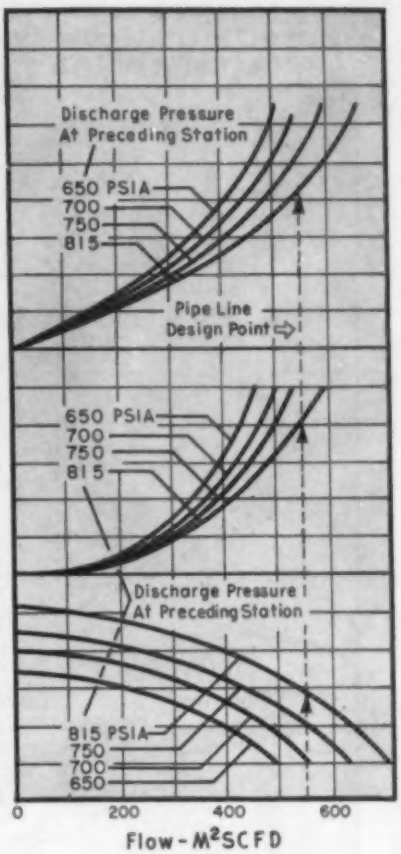

Fig. 6 65 Mile Station Spacing

Operating conditions govern compressor selection. Compressor characteristics are selected for each operating condition, plotted in terms of actual inlet volume, pressure ratio, and horsepower divided by inlet pressure. Figure 10 shows the compressor characteristic for the initial condition, where one unit per station is used. Figure 11 shows the combined characteristic of two compressors in series required for the intermediate condition, and Figure 12 shows the performance of one of these compressors operating alone. For the ultimate condition, Figures 13, 14 and 15 show the characteristics of three compressors in series, two compressors in series, and a single compressor, respectively.

It is very important to consider all operating conditions which may occur before selecting the final compressor characteristic. Referring to Figure 10 for the initial design, the 130-mile line shows where operating points would fall for various flows with all stations running. The 260-mile line shows operating points with only alternate stations running. These operating lines are obtained directly from Figures 8 and 9. Maximum flow, with all stations running, is established by the power limit (115 percent or 5750 horsepower), and maximum flow with alternate stations running is established by the speed limit (110 percent).

Where multi-unit stations are used there are more possible combinations of operating compressors and the selection of a proper compressor characteristic becomes slightly more complicated. Figures 11 and 12 show the performance of compressors for the intermediate condition. They illustrate typical operating points to be checked so proper compressors are selected for this phase of pipe line growth. Pipe line characteristics for 65-mile and 130-mile spacing from Figures 6 and 8 are shown on both the single and two-unit curves

The performance of compressors selected for the ultimate operation of the pipe line are shown in Figures 13, 14, and 15. Pipe line charactertistics for different station spacings are again superimposed on the compressor characteristics to show quickly the operating points at various flows.

Performance characteristics for emergency operation. Emergency operations along a pipe line are periodically encountered. One or more units in a station—even a complete station—may unavoidably be "down." When this occurs the stations preceding the down station operate normally along the pipe line characteristic at reduced loads but at full discharge pressure. However, the station or stations following the down station will operate at points varying from the normal pipe line flow characteristic.

From these unusual operations, several examples of emergency conditions for each of the initial, intermediate and ultimate designs are cited.

Initial design 130-mile station spacing. For the initial design with 130-mile station spacing and one unit per station two phases of an emergency operation, with one station down, have been analyzed with the use of Figures 8, 9 and 10.

(Illustrations on Page 42. Text Continued on Page 43.)

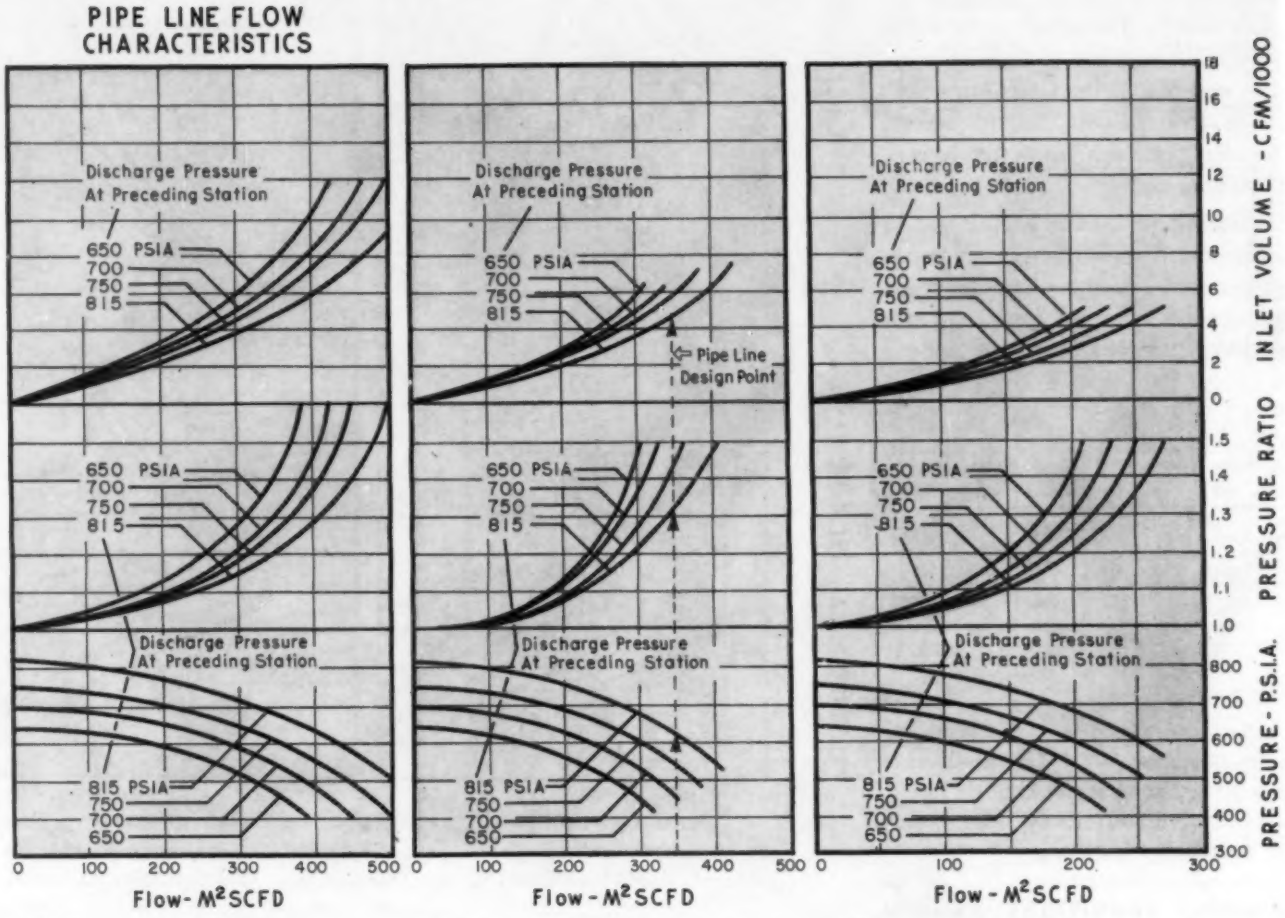

Fig.7 97.5 Mile Station Spacing

Fig.8 130 Mile Station Spacing

Fig.9 260 Mile Station Spacing

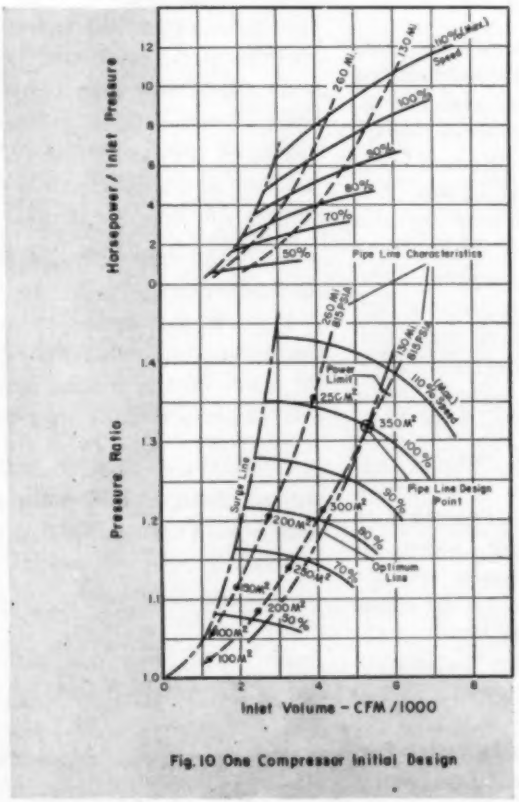

Fig.10 One Compressor Initial Design

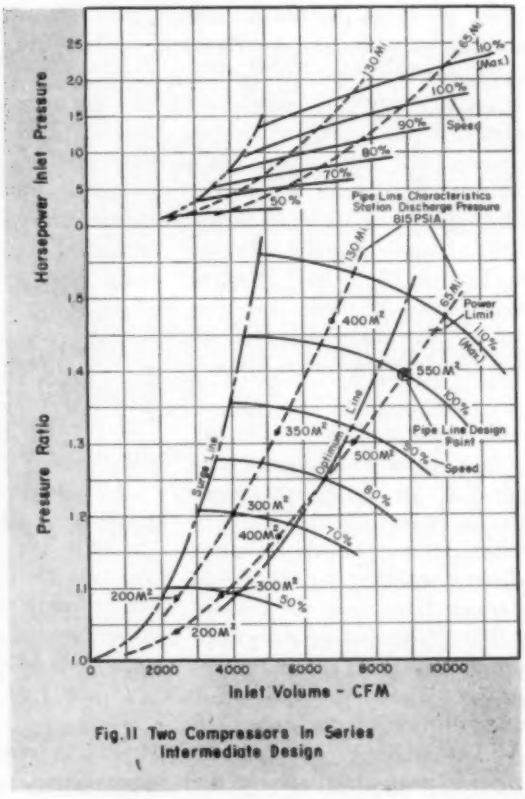

Fig.11 Two Compressors In Series Intermediate Design

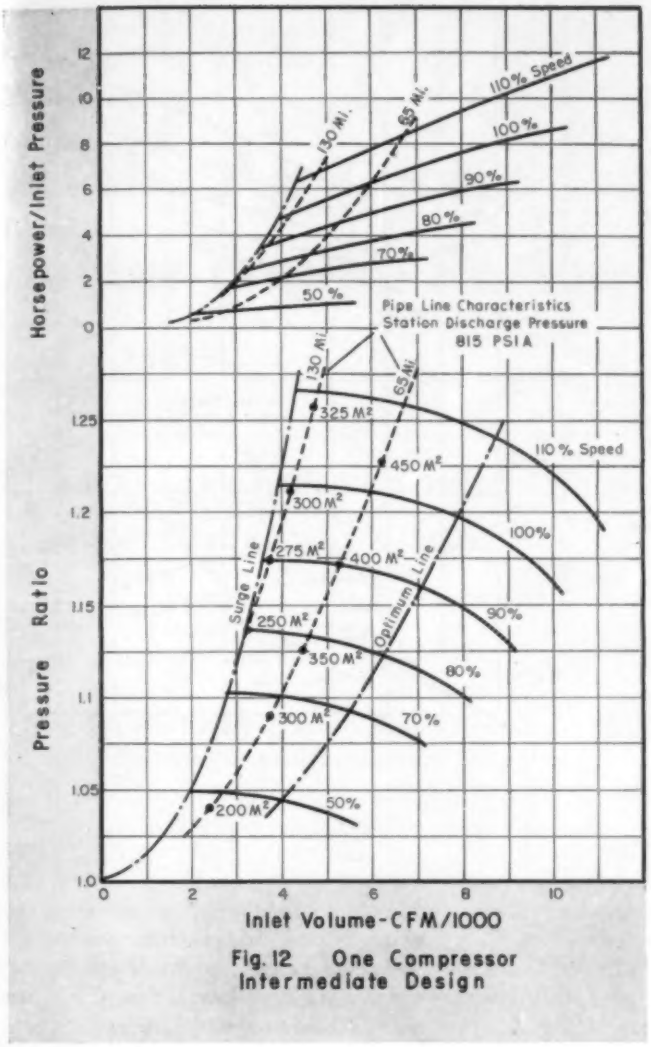

Fig. 12 One Compressor Intermediate Design

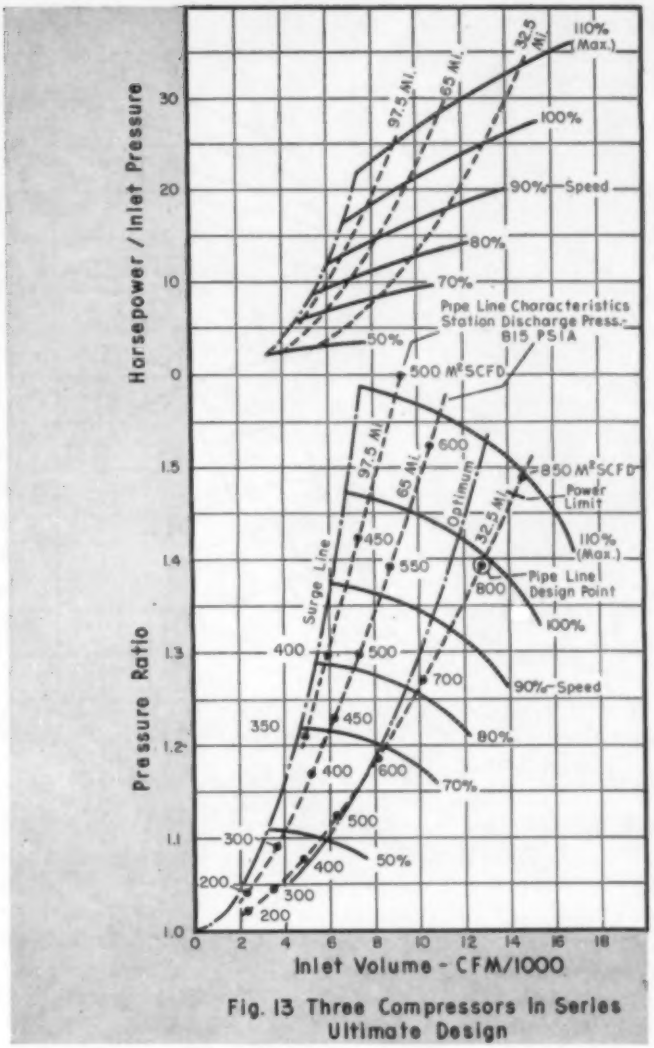

Fig. 13 Three Compressors In Series Ultimate Design

CONDITION 1

Maximum Flow-Full discharge pressure attained in the first station following the down station.

Station	A	B
Units operating	0	1
Flow—M²SCFD	..	265
Inlet Pressure—PSIA	..	575
Horsepower	..	4900
Speed	..	110%
Discharge Pressure—PSIA	..	815

CONDITION 2

Maximum flow—Full discharge pressure attained in the second station following the "down" station.

Station	A	B	C
United Operating	0	1	1
Flow—M²SCFD	..	290	290
Inlet Pressure—PSIA	..	520	580
Horsepower	..	5150	5225
Speed	..	110%	110%
Discharge Pressure—PSIA	..	730	815

Intermediate design—65-mile station spacing. For the intermediate design condition with 65-mile station spacing and two compressors per station, two typical emergency operations are again considered using Figures 6, 8, 11 and 12:

CONDITION 1

Maximum Flow—One station down—Full discharge pressure attained in the following station.

Station	A	B
Units Operating	0	2
Flow—M²SCFD	..	417
Inlet Pressure—PSIA	..	530
Horsepower	..	9650
Speed	..	110%
Discharge Pressure—PSIA	..	815

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CONDITION 2

Maximum Flow—One Compressor down in one station—Full discharge pressure attained in that station.

Station	A
Units Operating	1
Flow—M²SCFD	470
Inlet Pressure—PSIA	649
Horsepower	5450
Speed	110%
Discharge Pressure—PSIA	815

Ultimate design—32.5-mile spacing. For the ultimate design condition with 32.5-mile spacing and three compressors per station, three emergency conditions have been analyzed using Figures 5, 6, 13, 14 and 15.

CONDITION 1

Maximum Flow—One compressor down in two adjacent stations—Full discharge pressure attained in the following station.

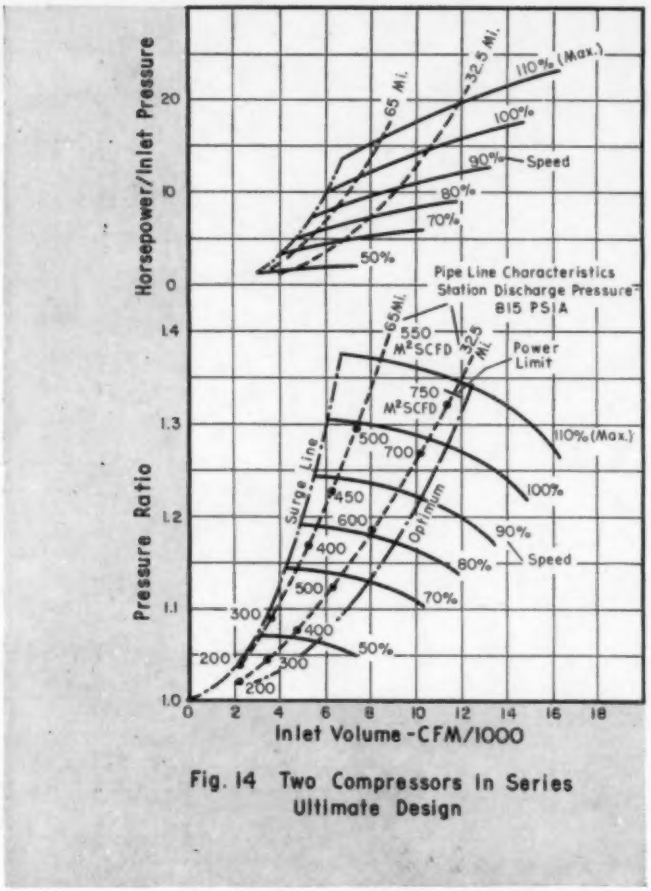

Fig. 14 Two Compressors In Series Ultimate Design

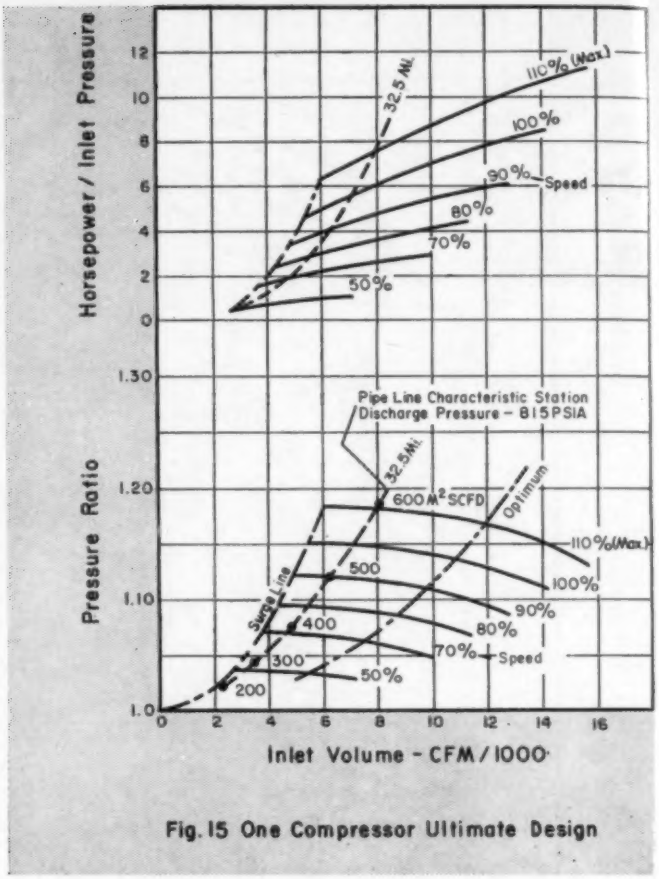

Fig. 15 One Compressor Ultimate Design

Station	A	B	C
Units running	2	2	3
Flow—M²SCFD	775	775	775
Inlet pressure—			
PSIA	600	575	525
Horsepower	11500*	11500	16700
Speed	108.5%	109.5%	109%
Discharge pressure—			
PSIA	798	768	815

*—Maximum.

CONDITION 2

Maximum Flow—Two compressors down in one station—Full discharge pressure attained in the second following station.

Station	A	B	C
Units running	1	3	3
Flow—M²SCFD	740	740	740
Inlet pressure—			
PSIA	621	500	540
Horsepower	5750	16500	16300
Speed	110%	110%	108.5%
Discharge pressure—			
PSIA	728	754	815

CONDITION 3

Maximum Flow—One station down—Full discharge pressure attained in the second following station.

Station	A	B	C
Units running	0	3	3
Flow—M²SCFD	..	650	650
Inlet pressure—			
PSIA	..	468	530
Horsepower	..	14650	14850
Speed	..	110%	109%
Discharge pressure—			
PSIA	..	716	815

All of these unusual operating points are found to fall well within the operating range of the compressor characteristics. A complete analysis of probable emergency conditions such as these must always be included in the compressor selection procedure.

Special points for selecting characteristics. As shown in Figures 10, 11 and 13, the compressor characteristic is usually selected so that the pipe line design point occurs slightly above the optimum flow line for the compressor and at a speed low enough that the overload capacity of the driver may be fully utilized.

This leaves a broad range between normal operation and the stability limit, or "surge line," of the compressor. Most of the reduced load operation occurs within these limits. It is interesting to note that for very low flows in the pipe line, such as might be encountered during line packing, the compressors are farthest from surging when all units in all stations are operated. This is true even though the pressure ratio and horsepower required are very low. Thus, if surging started with only two machines running in a three unit station, it could be stopped by starting the third machine and operating all three at lower speed.

Compressor characteristics selected for this study have moderately sloped pressure-volume characteristics; the best for most installations. Either flatter or steeper characteristics may be appropriate in special case. These can be achieved by adjusting impeller proportions and blade angles. Where constant speed drivers are used, adjustable inlet guide vanes ahead of the impeller can be designed to simulate, to some degree, the effect of varying speeds.

Step-up or step-down gears are used where optimum speeds of compressor and driver cannot be matched satisfactorily. Many other design features are available for special circumstances.

The centrifugal compressor is a "natural" for large, modern pipe lines. It is reliable, efficient, easy to operate and simple to maintain. With good engineering it can be a valuable tool in the business of moving gas to market. —**The End**

Intake Air Cooled for Better Engine Performance

Detonation can be minimized and horsepower increased. Here's how it's done.

By LYNN K. FINNEY, Assistant Gas Engineer,
Kettleman North Dome Association

Cooling intake combustion air in hot climates improves engine performance by minimizing detonation and increasing horsepower. This is the belief of several manufacturing companies and a number of operators as well. Several companies have recently developed equipment for cooling combustion air. One has developed a package unit to convert exhaust gas waste heat into refrigeration. This unit provides a source of chilled water which, in turn, is used to cool intake air. The principal parts of the unit are the waste heat boiler which generates steam and the hermetically-sealed refrigeration system.

It is surprising that more thought has not been directed along these lines before. The principle long has been recognized by motorists who experience more detonation and loss of engine efficiency on hot days as compared to the high efficiency and lack of detonation experienced on cooler days or nights.

A huge aluminum reduction plant recently was constructed in Texas across a bay from Corpus Christi. Forty-two 16 cylinder, four cycle turbocharged natural gas engines rated at 3700 horsepower each, are installed in this pant to drive electric generators. Each of these large gas engines is equipped with an air filter, which not only cleans the engine air, but also automatically cleans itself. In addition, this clean combustion air is then pre-cooled by a redwood evaporative cooler before being used in the turbocharger.

It has been well established by the engine manufacturers that any engine, gas, gas diesel or full diesel either two cycle or four cycle must be derated about two percent for each 10° rise in ambient air temperature above 90° F. (See Figure 1). It is clearly evident, therefore, that operators must plan to keep the combustion air from heating up if they expect to obtain the full rated horse power from their engines.

Several years ago two air filters were purchased that were designed to not only clean the air, but also cool it with a water spray and wash off the accumulated dirt on the filtering medium. Tests of these filters proved that the filtering medium were excellent, but operators were unable to keep them clean with the water spray and such a large amount of water was necessary to achieve any air cooling they became uneconomical to operate.

However, after discussing with other operators and engine company representatives this problem of high temperature combustion air, it was decided to experiment with air cooling in order to determine if any improvement in operation could be expected from our older horizontal type engines. These old air cleaners were rebuilt, attempting to retain the good cleaning features and adding air cooling by water evaporation. After several attempts which always seemed to develop something wrong, a unit was built which indicated a satisfactory job of cleaning and attained some reduction in air temperature.

Many horizontal type gas engine driven compressors were installed years ago without much thought being given to building ventilation or the proximity of the air intake lines to the hot exhaust lines. Changes in the buildings have resulted in better ventilation and lower temperatures within the buildings, but the intake air temperature continues to be above the atmospheric temperature, and that goes well above 100° much of the time in the summer.

The test engine was given a thorough overhaul. The power end had new sealing rings installed on the piston, new intake and discharge valves and seats, the cam box worked over with new bushings installed wherever necessary. The old cams were replaced with special high lift and hardened cams and the old trip type magnetoes replaced with a single high tension rotary magneto making it possible for accurate timing.

The compressor end has a 10½-inch Class B cylinder on the first stage and a 6-inch Class A cylinder on the second stage. The pistons for both these cylinders were removed and new bronze rings installed. All intake and discharge valves in both cylinders were replaced with overhauled valves. The 10½-inch cylinder has 10.5 percent built in clearance and four bottles with 397.23 cubic inches added clearance, making a total of 28.94 percent.

Tests indicated that the effective horsepower developed had been increased 4.75 percent to 178 HP. with the installation of the new cams and improved ignition.

The tests consisted of operating the engine under a series of increasing loads, first with the combustion air uncooled, then the same tests with the combustion air cooled, and observing and recording the engine condition, the quantity of gas compressed and the horsepower used. Conditions for each comparable test were held as near constant as possible, although

atmospheric temperature, gas temperature and gas pressure varied some during the days used to complete the tests. Before each test and every 15 minutes during the test, indicator cards were run on both sides of the engine.

The results and operating conditions of each series of tests are shown in Tables 1, 2 and 3.

For Test No. 1 Series No. 1 the intake gas pressure was set at 45 pounds, which loaded the engine to its rated 170 HP. before the installation of the new cams. The engine easily handled this load, running up against the governor all the time. The water through the engine jackets had a 35° rise which is too much for good operation, but is normal for this plant.

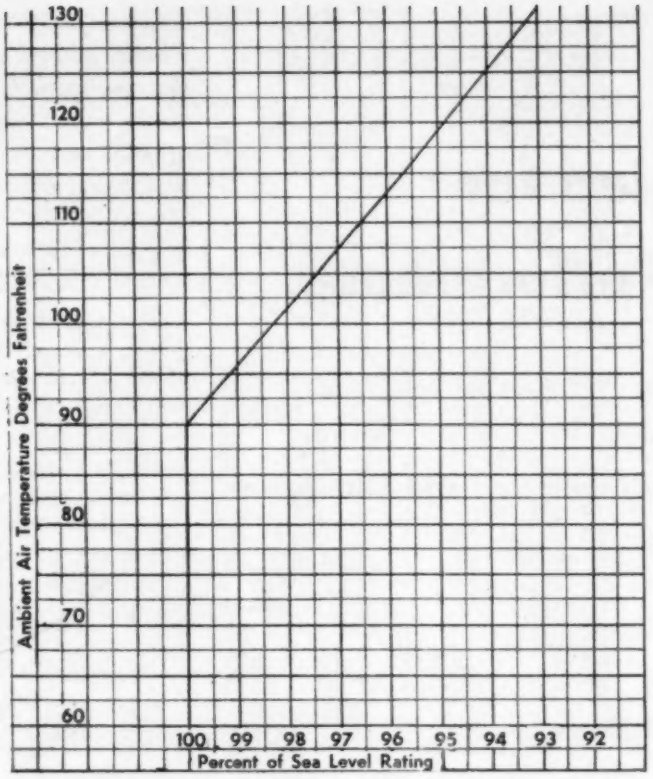

FIGURE 1—Temperature derating for all gas, gas-diesel, and diesel engines. This sheet used for all 2- and 4-cycle gas, gas-diesel, and diesel engines, whether atmospheric or turbocharged.

The gas pressure was increased to 50 pounds for the second test of this first series. The combustion air temperature was 93° and the temperature rise in the jacket water was 37°. It required 177 HP to compress the 1349 MCF/24 hours of gas from 50 pounds to 460 pounds. The engine handled this load without any loss of speed or any detonation, although it did not run up against the governor as it did in the first test.

The pressure of the intake gas was again increased 5 pounds to 55 pounds for the third test and 183 HP was used to compress this gas rate of 1454 MCF/24 hours. The temperature of the combustion air was up to 99° and the rise in jacket water temperature climbed to 41°. The engine showed signs of overloading, gradually losing speed, while detonation, at first only slight, became quite heavy with continued operation as the test progressed.

The second series of tests were exact duplicates of first, except that the combustion air was cooled. It was un-

TABLE 1

1st Series—Combustion Air Uncooled

Test No.	Atmos. Temp.	Combustion Air Temp.		Vacuum Air Line Cooler To Eng.	Jacket Water Temperature		R.P.M.	H.P. Used	GAS COMPRESSED					24 Hour
									1st Stage		2nd Stage			
		Without Cooling	With Cooling		In	Out			Intake Pr.	Intake Temp.	Intake Pr.	Intake Temp.	Disch. Pr.	Rate M.C.F.
1	88°	91°	....	1.0"	111°	146°	200	170	45 lb	105°	160 lb	225°	460 lb	1244
2	88°	93°	....	1.0"	110°	147°	200	177	50 lb	106°	175 lb	225°	460 lb	1349
3	95°	99°	....	1.0"	111°	152°	200	183	55 lb	109°	190 lb	225°	460 lb	1454

TABLE 2

2nd Series—Combustion Air Cooled

Test No.	Atmos. Temp.	Combustion Air Temp.		Vacuum Air Line Cooler To Eng.	Jacket Water Temperature		R.P.M.	H.P. Used	GAS COMPRESSED					24 Hour
									1st Stage		2nd Stage			
		Without Cooling	With Cooling		In	Out			Intake Pr.	Intake Temp.	Intake Pr.	Intake Temp.	Disch. Pr.	Rate M.C.F.
1	100°	102°	92°	1.3"	115°	150°	200	169	45 lb	119°	161 lb	239°	455 lb	1244
2	76°	92°	84°	1.3"	111°	147°	200	180	50 lb	107°	173 lb	232°	455 lb	1379
3	86°	96°	88°	1.5"	110°	146°	200	193	55 lb	113°	182 lb	234°	455 lb	1541

TABLE 3

3rd Series—Combustion Air Cooled

Speed 210 R.P.M.

Test No.	Atmos. Temp.	Combustion Air Temp.		Vacuum Air Line Cooler To Eng.	Jacket Water Temperature		R.P.M.	H.P. Used	GAS COMPRESSED					24 Hour
									1st Stage		2nd Stage			
		Without Cooling	With Cooling		In	Out			Intake Pr.	Intake Temp.	Intake Pr.	Intake Temp.	Disch. Pr.	Rate M.C.F.
1	92°	100°	91°	1.3"	112°	146°	210	176	45 lb	116°	162 lb	239°	455 lb	1295
2	91°	100°	91°	1.3"	110°	148°	210	186	50 lb	117°	174 lb	239°	450 lb	1444
3	90°	98°	89°	1.5"	110°	150°	210	199	55 lb	118°	185 lb	241°	450 lb	1590

fortunate that during the days that it was necessary to run these tests, the weather turned cooler, making it impossible to obtain as much air cooling as at other times.

In the first test of the second series the combustion air was cooled 10°, although this was the one day when the average atmospheric temperature did reach 100°. The cooled air with a temperature of 92° was still 1° higher than its comparable test of the first series. It will be noted from Table 1 and Table 2 that the conditions were practically indentical for both tests. However, more vacuum was required to pull the air through the dampened filters. The engine again ran up against the governor, handling this load without any apparent effort.

The second test of this series was run on one of the coolest days experienced this summer in Kettleman Hills. A breeze right off the ocean cooled the hills so that the average atmospheric temperature during the test was only 76°. The dry combustion air was 92° and we were able to cool this to 84°, which was 9° less than the comparable test. The conditions for this test were quite similar to the test at 50 pounds with uncooled air, although a little more gas was compressed due to lower discharge pressures and a small increase in horse power was developed. The engine handled this light overload without any signs of overheating, slowing down or detonation.

As in the first series the intake gas pressure was increased to 55 pounds for the third test. The cooled combustion air was 88° or 11° cooler than the comparable test with uncooled air, and more vacuum was required in the air line to get the cooled air into the cylinder. It is important to note that the rise in the jacket water temperature remained constant with the cooled combustion air, even with the horsepower out-put increased. Possibly this is due partially to some moisture being introduced into the cylinders along with the cooled air. The gas conditions changed enough to allow 1541 MCF/24 hours, an increase of 5.98 percent to be compressed. This also increased the horse power out put to 193, which is a 5.46 percent increase. The engine ran right up to 200 RPM, although not up against the governor as in the previous tests and there was not any detonation whatsoever.

Good Old Days? Lines were cleaned and reconditioned years ago with this machine powered by a Model T Ford engine. It was limited to cleaning pipe 6-12 inches in diameter, and a crew really had to move to clean 400 feet an hour. The pipe is being raised and lowered into ditch with hand-cranked Wheatley tripod winch at right.

Additional tests at even higher pressure and heavier loads were impossible as there is not any gas available at this plant at pressure above. 55 pounds. However, a third series of tests was run as shown by Table 3, with the engine speeded up to 210 RPM. There was as expected a small increase in the quanity of gas compressed at 45- and 50-pound intake pressure, but the engine did not run as well as at 200 RPM. When the intake pressure was raised above 50 pounds, detonation began and at 55 pounds became quite strong. The temperature increased and the speed began to fall off. Of course, at 199 HP the engine was considerably overloaded and it just would not handle this load for any length of time.

Although, with field-made cooling equipment, it was impossible to lower the temperature as much as desired, it is definitely known that the operation of this engine was considerably improved, with more gas being compressed and after all that's what we are looking for.

From the test data it appears that with uncooled air, a load of approximately 177-180 HP is all that this engine can be expected to handle in continuous service. But with the combustion air cooled as little as we accomplished during these tests, a load of 193-195 HP should be handled without trouble or damage to the engine. This is an 8.33 percent increase in horsepower output and is certainly an easy and not too expensive way to get it. The results of our tests do not follow the curve as shown in Figure 1, but it is believed that this curve applies to modern multi-cylinder engines and besides the tests were made near or below the 90° shown for 100 percent horsepower output anyway.

Results of this test were encouraging and an attempt will be made to improve the cooler type air cleaner and run some additional tests. If the results of these tests show added improvement in operation, the installation of combustion air cooling on other horizontal type engines will be considered.

ACKNOWLEDGMENT

Presented at fall meeting of California Natural Gasoline Association, Oct. 9 and 10, 1952, Los Angeles.

Turbocharging Two-Stroke Gas Engines

The introduction of the turbocharged compressor with its savings in fuel, cooling duty and over-all installation cost may prove to be an important contribution to the gas transmission industry.

By CARLTON A. CHAMBERLAIN and GEORGE A. BOLLMAN,
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WHY SHOULD a two-cycle gas engine be turbocharged? It is already recognized as simple to operate, compact, reliable and efficient. What else does it need to further its place in its field?

Lower fuel consumption and higher power output always have been demanded of the engine—without sacrificing any of the engine's advantages. The two-cycle gas engine must positively pump the air it uses for combustion and scavenging. The crankshaft power required to pump this air on non-turbocharged engines is a significant part of the total developed crankshaft power and the total engine fuel consumption. Turbocharging is a practical means of relieving the engine crankshaft of this duty, and at the same time, making an increase in mean effective pressure possible.

What are the requirements for increasing the mean effective pressure and lowering the specific consumption of the two-cycle gas engine? This depends on how much of an increase in power is to be considered. For this discussion, an increase in bmep of 33 percent of the normal power rating will be used. This increase requires that more fuel be burned than is possible in an unsupercharged engine without exceeding mixture limitations or thermal loading limits.

There are at least four prerequisites to increasing bmep this amount while retaining an ample overload capacity, and, at the same time reducing specific fuel consumption:

1. Since the higher mean effective pressures require that there be an increase in the fuel burned, the trapped air density must be raised in order to maintain the fuel-air mixture. There is a definite range of mixtures which can be spark-ignited in the gas engine. Excessively lean mixtures result in misfiring and poor specific fuel consumption. Excessively rich mixtures cause high explosion pressures, high thermal loading and, ultimately, detonation.

2. The total air flow must be increased to fulfill the scavenging requirements of the engine. It is necessary to maintain a certain differential between inlet and exhaust pressures in order to purge the burned gases from the power cylinders. Thus, at the higher pressure levels, the weight flow of charging air must be greater to accomplish scavenging. It is customary to refer to scavenge-air flow in terms of the excess of free-air volume over the displacement of the power pistons.

3. Low thermal loading of the engine must be maintained when the mean effective pressures are raised. This means that in spite of higher mean pressures of the gases in the combustion chamber during the power cycle, the mean cycle temperature and consequently the mean temperature of the cylinder walls, cylinder heads, and pistons must not be allowed to rise.

This can be accomplished when the air flow is proportional to load, when scavenging efficiency is maintained, and when the fuel-air ratio does not rise. It is essential that the thermal loading not go up in order that the service life of the vital engine parts will not be impaired.

4. The mechanical efficiency of the engine must be improved for better thermal efficiency. The mechanical efficiency of an engine is the ratio of useful or brake work compared to the total power developed in the power cylinders. The difference in these two factors is composed of friction and parasitic loads of auxiliary equipment such as oil pump, lubricators, magnetos, scavenging pump, and so on, required for actually running an engine. On a non-turbocharged two-cycle engine, as much as 30 to 50 percent of the total of friction and parasitic load is consumed in pumping scavenging air.

The proposition that an airflow increase must accompany the mean-effective-pressure increase is now evident, but there is no escaping the fact that a considerable increase in power is necessary to pump the greater air flows at higher pressures. The prospects for lowering specific fuel consumption would be dim indeed if the power for this increased scavenging load had to come from the engine crankshaft. On the contrary, the crankshaft must be relieved of even the normal scavenging duty to permit any sizable reduction in specific fuel consumption. The removal of this load from the crankshaft presents the greatest opportunity for improving the over-all efficiency of the engine.

Additional features desirable. In meeting the foregoing requirements for attaining more power with less fuel, certain other desirable characteristics of an engine also should be considered. For example, it should: **1.** be easy to start and run at idle conditions. This means that the engine must have a positive air flow through the power cylinders when the source of starting energy is cut off. The air flow at idle has to be such that the engine will accelerate smoothly up to normal speeds and loads. An engine with a compressor load can be, and frequently

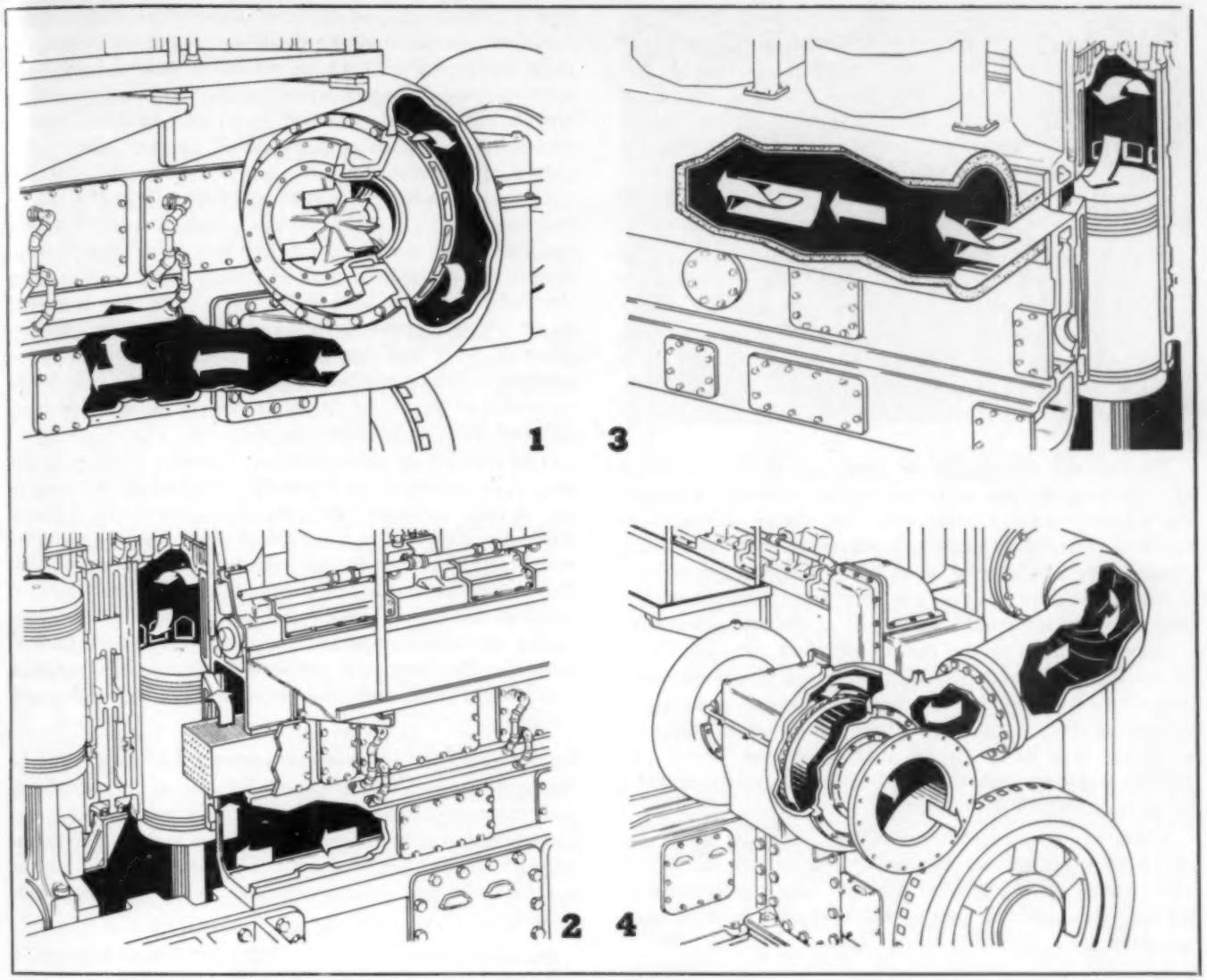


FIGURE 1

1. Filtered air is pumped by the centrifugal compressor impeller of the turbocharger into the main scavenging air passage which is built into the cylinder block. Because it is far more efficient to convert velocity to static pressure in a centrifugal compressor impeller than in a diffuser, practically all of the work of compression is performed in the impeller to assure the highest possible efficiency. **2.** Before entering the power cylinders, scavenging air passes through individual built-in intercoolers. Under most full load conditions, little or no intercooling is required. Thermostatically controlled water is admitted to the intercoolers during periods of high ambient air temperature or temporary overload. The amount of cooling is determined by air temperature in the scavenging air passage. Multiple directional ports assure thorough scavenging. **3.** The exhaust gases leave the power cylinder through large exhaust ports. Passages in the cylinder block and the lead in passages to the exhaust manifold are streamlined to assure minimum energy loss from the gases going to the turbocharger. The exhaust ports are uncovered by the power piston as it approaches the end of the power stroke. The piston, subsequently, uncovers the scavenging ports to permit clearing of the cylinders of exhaust gases. **4.** Hot exhaust gases of elevated pressures enter the turbine of the turbocharger. Here they are expanded in the radial-inflow turbine. In expanding the gases, rotative energy from the turbine is used to drive a centrifugal compressor impeller through a forged steel shaft. This impeller pumps air for combustion and scavenging at approximately seven pounds per square inch psi at rated load.

is, fully loaded over a period of a very few seconds. This should be accomplished with no tendency to stall.

2. The factors which must vary with engine load, such as fuel, scavenging and exhaust pressures, and air flow, should do so automatically. If this can be achieved as a normal characteristic of the engine and not by means of added controls, so much the better.

3. Cooling duty should be kept at a low level to minimize the requirement of cooling water and the cost of installing and maintaining cooling equipment.

4. The quieter an engine is in operation, the more attractive it is. The noise level of an engine affects not only the operating personnel but also the persons living or working close to an installation. Where several engines are grouped together in one or adjacent buildings, the noise level can be a serious problem.

When the characteristics desired and the requirements for obtaining these characteristics in an engine are known, the possibilities of obtaining them can be explored. Consider, for example, an engine having crank-shaft driven scavenging pumps and see if it is practical to extend its load range and lower the fuel consumption, bearing in mind that the density of the air charge must be increased and the parasitic load decreased.

Tackling the problem. Assume an engine rated at 77 bmep with a mechanical efficiency of 79 percent including the scavenging load.

The engine scavenging and exhaust pressure could be

raised by placing a valve or restriction in the exhaust line. However, the power to pump the scavenging air would go up and the rate of air flow would be decreased. The inlet-to-exhaust pressure differential would go down at the higher pressure level, thereby hurting the scavenging efficiency. Such a method is ruled out, then, because the parasitic load would be increased, thus limiting any possible increase in thermal efficiency, and the reduced air flow would raise the thermal loading of the engine.

The engine output could be increased somewhat by increasing the capacity of the scavenging pumps, assuming that the higher air flow cooled the trapped charge and added slightly to the trapped pressure because of a higher pressure drop through exhaust ports. But since the added air-flow capacity adds to the indicated power required, the potential gain in brake load would be nullified.

Cooling the scavenging air alone offers the possibility of increasing the density of the charge without increasing the scavenge load. Conceivably, the charge temperature could be lowered 30 degrees in this manner if the cooling means were available. A 4 to 5 percent increase in load should be possible, but only a very slight gain in specific fuel consumption would follow. If, at the same time, the compression ratio in the power cylinders were increased by an amount which would give the same compression temperature as would be obtained without cooling, a significant theoretical gain in fuel consumption would be available. It is likely though that detonation would still prevent running with the compression pressures implied by such a volume-ratio change.

There are many variations of the foregoing proposals which have been tried, but none of them can achieve a wider range of engine load with no increase in thermal loading and with a substantial decrease in fuel consumption.

Turbocharger supplies answer. It appears that the fuel consumption of the present high-compression engines can best be lowered by reducing the scavenging load on the crankshaft. If this load is removed from the crankshaft, the energy must be supplied from some other source in the engine. The exhaust gas contains the largest amount of heat rejected from the engine (as much as 40 percent of the heat input) and is at a relatively high temperature level. It is therefore the best potential source of energy for this purpose. But, regardless of its temperature, it is not a useful medium unless its pressure is elevated above atmospheric.

A turbine placed in the exhaust line of the engine raises the back pressure on the exhaust in the same way that a fixed orifice would. By expanding the hot exhaust gases to atmospheric pressure, the turbine recovers energy which is absorbed by a scavenging blower on the same shaft. The higher the engine load, the higher the scavenging-power requirement, but also the greater is the exhaust energy available for this duty. With a load increase, the exhaust-gas energy is increased in the form of a rise in temperature.

The turbine accelerates to a higher speed, and by driving the blower along with it, produces an increase in inlet airflow which in turn modifies the rise in exhaust temperature, Figure 1. With the increase in air and exhaust flow there occurs a rise in supercharging pressure level due to the restriction to flow imposed by the turbine. Air flow, and inlet and exhaust pressures are automatically readjusted for each increment of engine load, both up and down. The turbocharger, then, varies the air flow and charge density in relation to engine load, and it accomplishes this without impairing the mechanical efficiency of the engine.

If the turbocharger is matched properly to the engine and its component efficiencies are high enough, the thermal loading of the engine is even less than for a conventional, non-turbocharged high-compression engine. The thermal loading is held down in spite of the increased mean effective pressures by virtue of the increased cooling effect of more and denser scavenging air, and because a somewhat leaner mixture can be employed. This lower thermal loading of the engine is evidenced by the sharply reduced jacket water-cooling duty.

The amount of supercharging becomes limited in the two-cycle gas engine by the temperature of the scavenging air. As the pressure level is raised, so is the blower-discharge temperature; at some point the compression temperature for the power cylinder will become so high that detonation cannot be avoided. At this point, the load range of the engine can be extended by cooling the scavenging air after compression in the blower. Such cooling forestalls the detonation point by lowering the compression temperature and by providing better cylinder-wall cooling.

Comparison of non-turbocharged and turbocharged two-cycle engine. Examine quantitatively now the comparison between the non-turbocharged and the turbocharged version of a two-cycle loop-scavenged cylinder of 750 displacement. The heat balance of the non-turbocharged cylinder breaks down approximately as follows:

Brake horsepower	**250**	**2545 Btu/bhphr**
Scavenging hp	**30**	**306**
Auxiliaries	**4**	**41**
Radiation	**8**	**80**
Water- and oil-cooling	**216**	**2200**
Exhaust gas	**278**	**2828**
Fuel	**786**	**8000**

The friction horsepower is, of course, included in the cooling duty in a heat balance. Its value, in the case of this cylinder, is 33 horsepower or 336 Btu/bhphr. This power, plus the scavenging load of 30 hp and the power to drive the auxiliaries, 4 hp, comprise the parasitic load on the engine and, when added to the bhp, show that the indicated horsepower of the cylinder must be 317. This is a mechanical efficiency of 79 percent. If we take this same cylinder and turbocharge it, raising the bhp by ⅓, to 333 bhp, we can assume the same friction load of 33 hp, the same auxiliaries, 4 hp, and no scavenging load. The indicated horsepower has risen to 370 hp, an increase of only 16½ percent. This shows a mechanical efficiency of 90 percent. Following is the new heat balance:

Brake horsepower	**333**	**2545 Btu/bhphr**
Auxiliaries	**4**	**31**
Radiation	**8**	**60**
Cooling	**205**	**1564**
Exhaust	**366**	**2800**
Fuel	**916**	**7000**

It will be seen that thermal efficiency of the cycle itself, i.e., the ratio of "indicated" horsepower to fuel

remains very nearly constant at about 40.3 percent which is to be expected in utilizing the same power-cylinder compression ratio in both cases. The exhaust energy, however, has risen in the case of the turbocharged cylinder from 35.4 to 40 percent. This is due to the greater rate of heat transfer to the exhaust from the metal parts which results from the greater quantity of excess air.

It is reflected in the lesser transfer of heat to the water and oil, which quantity has been reduced from 27.5 percent of the fuel to 22.4 percent. To put this in other terms, the cooling duty has been reduced from 550,000 Btu/hr to 521,300 Btu/hr for a cylinder of the same dimensions. This indicates that the cylinder walls, piston head, and piston rings are operating at a lower mean temperature and that the thermal loading of the cylinder is less when turbocharged.

Now examine the operating conditions presented to the turbocharger. We defined excess air as the volume of flow, measured at ambient conditions, in excess of the displacement of the piston. If we assume atmospheric conditions of 70 F. and 14.3 pounds per square inch absolute, the mass flow of air through the cylinder is

$$(\text{percent} + 1) \times (0.0729) \times (750 \text{ cfm displ}) \text{ lb/min}$$

Now, it will be remembered that the heat transferred to the exhaust was very nearly equal to the energy of the indicated horsepower, so we can say it is equal to

$$\text{Ihp} = \frac{\text{imep } (144) \ (\text{cfm displ})}{778} \text{ Btu/min}$$

The temperature rise, ΔT, of the air in passing through the cylinder during the power cycle is equal to the quantity of heat added divided by the specific heat and the weight flow of air per minute. For simplicity, assume that the mean specific heat is constant and equal to 0.248 Btu/per lb per degree F. in the range of temperatures in which we are interested.

$$\Delta T = \frac{\text{imep } (144) \qquad (\text{cfm displ})}{(\text{percent} + 1) \ (0.0729) \ (\text{cfm displ}) \ (0.248) \ (778)} = \frac{1.021 \ (\text{imep})}{(\text{percent} + 1)}$$

Figure 2 shows this relationship in graphical form.

The turbine power in Btu per pound of exhaust gas is equal to

$$\eta_t \, C_p \, T_3 \left(1 - \frac{1}{R_t}^{\frac{n-1}{n}}\right)$$

in which η_t is the adiabatic efficiency of the turbine, and T_3 is the turbine-inlet temperature in degrees Rankine. We will assume again that the specific heat at constant pressure C_p, and the ratio of specific heats η, are constant and have mean values of 0.0255 and 1.35, respectively. R_t is the ratio of expansion in the turbine.

Similarly, the power the compressor will absorb is given by

$$\frac{C_p \, T_o}{\eta_c} \left(R_c^{\frac{n-1}{n}} - 1\right)$$

in which T_o is the inlet temperature, η_c is the adiabatic efficiency of the compressor, R_c is the ratio of compression in the blower and C_p and n have constant values of 0.240 and 1.40.

If we neglect the mass of the fuel being added to the flow of air, and assume that the mechanical efficiency of both turbine and blower is included in the efficiency

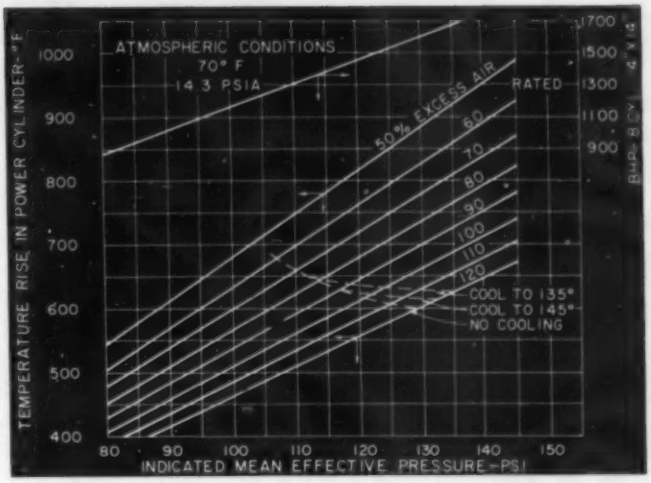


Fig. 2—Temperature rise in power cylinder versus indicated mean effective pressure.

terms of each component, we can equate these two factors as the turbine power must always equal the blower power.

Solving for T_3

$$T_3 = \frac{T_o C_p \left(R_c^{\frac{n-1}{n}} - 1\right)}{\eta_c \, \eta_t \, C_p \left(1 - \frac{1}{R_t}^{\frac{n-1}{n}}\right)}$$

Inserting 530 R for the atmospheric temperature T_o, and 0.84 and 0.80 for the turbine and compressor efficiencies, the equation becomes

$$T_3 = 816 \frac{R_c^{0.288} - 1}{1 - \frac{1}{R_t}^{0.280}}$$

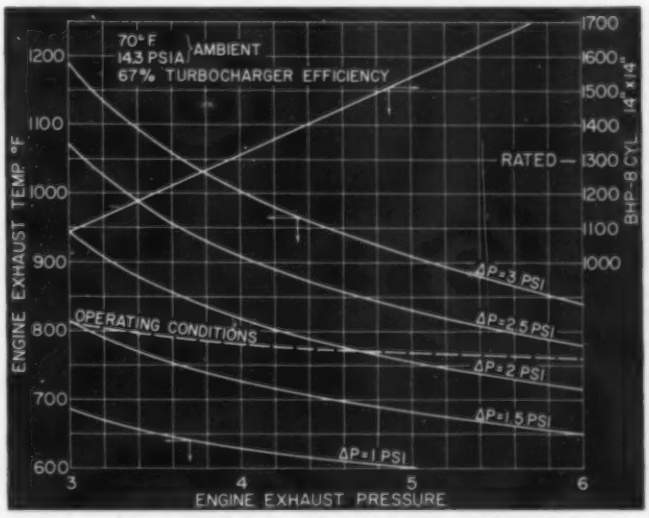


Fig. 3—Engine exhaust temperature vs. engine exhaust pressure.

From this equation, T_3 has been plotted in Figure 3 against P_3, the turbine-inlet pressure, psig, for various values of the pressure drop ΔP, through the power cylinder. The design of the cylinder ports will determine the pressure drop for a given rate of flow of excess air. This pressure drop must not fall below certain minimum

values if adequate scavenging of the cylinder is to be achieved.

Similarly, a supercharging pressure level, which will fall somewhere between the blower-discharge pressure and the turbine-inlet pressure, depending upon the relationship between the areas of the inlet and exhaust ports, must be chosen which will provide the proper density of air charge for each engine load.

How it works out in practice. The magnitude of the cylinder pressure drop and the supercharging pressure level which have been arrived at during the course of the development of the turbocharged engines at the authors' company are plotted in Figures 2 and 3. For example, at the rated load of 165 bhp on the 412-cfm-displacement cylinder, of which the mechanical efficiency is 83 percent, the indicated horsepower is 199. This is equivalent to 111 imep and to 1320 bhp (rated bhp) in an 8-cylinder engine. Referring to Figure 3, follow over from 1320 bhp on the scale and down to the line marked operating conditions.

This intersection indicates that the operating conditions will be 4.04 pounds per square inch gauge engine-exhaust or turbine-inlet pressure. The pressure drop across the engine will be about 1.8 pounds per square inch. The required turbine-inlet temperature will be 785° F. The blower-discharge pressure will be 5.84 psig which yields a discharge temperature of 130° F. with a 70 ambient temperature. Thus, a rise of 655° F. is required across the power cylinder.

Now, referring to Figure 2, follow over from the 1320-bhp point on the bhp scale and down to a point opposite 655° F. temperature rise. The resulting point on the graph indicates that the turbocharger will operate at a speed which will supply about 72 percent excess air. It will be noted that this point has fallen on a dashed line which has been plotted by tracing through this procedure for a range of load points. Branching off from this dashed line are two alternative dashed lines which indicate the modification of the operating conditions when intercooling of the blower-discharge air is introduced.

As another example, select the point on Figure 3 for 1700 bhp, the approximate overload capacity of this engine. This indicates that the engine exhaust pressure will have risen to 5.72 psig, and the pressure drop to about 2.3 psi. It shows the turbine-inlet-temperature requirement to have dropped off slightly to 763° F. This apparently paradoxical phenomenon results from the assumption that the turbocharger efficiency remains constant throughout the operating range.

Actually it generally will drop off slightly at maximum speed which will result in the "operating-conditions" line remaining more nearly at constant turbine-inlet temperature or rising slightly at the higher turbine-inlet pressures. Nevertheless, this decreasing of the temperature at higher engine loads has been observed on some units and the assumption of constant efficiency has been permitted here in the interests of simplicity.

The blower-discharge pressure resulting from the engine-exhaust pressure of 5.72 psig (a pressure drop of 2.3 psi from 8.02 psig) will produce a dischrage temperature of 160° F. (again with an ambient of 70° F.). This would result in a compression temperature so high that detonation would be encountered. Therefore the air is cooled back to 145° F. This means that a rise of 763 — 145 degrees or 618 degrees is required in the power cylinder. Now, going back to Figure 2, the 1700-bph point projected down to 618° F. temperature rise indicates that that turbocharger will have increased its speed sufficiently to provide over 120 percent excess air.

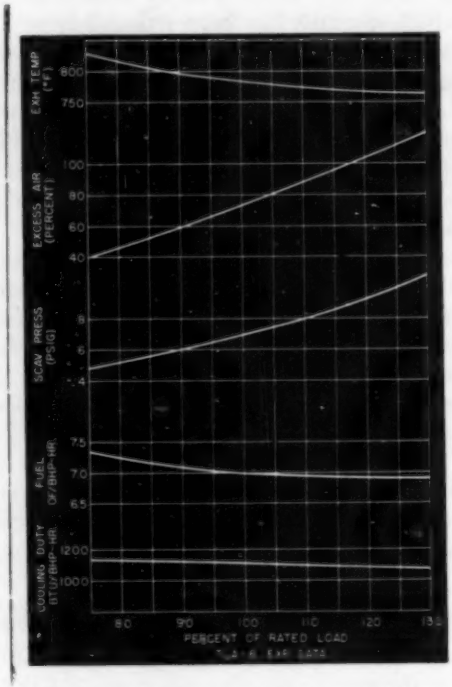


Fig. 4—Engine operating characteristics.

Figure 4 summarizes some of the engine operating characteristics as a function of load.

Function of mechanical overdrive. It is typical of any arrangement of a constant-pressure turbine driving a compressor which in turn supplies air to be expanded in the turbine after being heated (in the combustion chamber in the case of an internal-combustion gas turbine, and in the engine in this case) that the unit will not be self-sustaining below certain speeds regardless of the turbine-inlet temperature. Additional energy must be supplied in some form or another to prevent the turbocharger from decelerating below this critical point in speed.

Actually, a considerable margin should be allowed above this speed because turbocharger acceleration, as the turbine-inlet temperature is increasd, is very low in the region just above this critical speed. Without this margin, it would not be practicable to apply a large increment of load to the engine suddenly as the fuel mixture would become excessively rich until the turbocharger speed came up, and this could result in detonation or even stalling of the engine.

In order to accelerate the turbocharger to a point above this critical speed at the time of starting the engine, and to maintain it during periods of idling and very low-load operation, the authors' company has incorporated a mechanical drive linking the engine crankshaft to the turbocharger shaft through an over-running clutch. This drive also includes a hydraulic coupling to isolate the engine torsional vibrations from the high speed portion

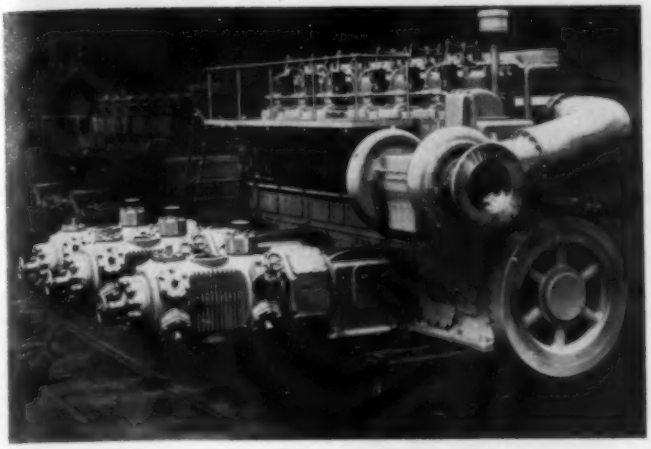


Fig. 5—View of new turbo-supercharged two-cycle gas engine.

of the drive. The clutch involves no frictional components, its action being accomplished by draining the hydraulic coupling when the drive is not required. It is required to transmit but a small fraction of the ultimate blower horsepower, and is, of course, completely disengaged during the vast majority of the operating time of the engine.

New turbocharged engine design. In spite of the comparatively small increase in the mechanical stresses on the engine, the indicated horsepower having been increased only 16 percent to gain the 33 percent increase in bhp, the company decided to design completely new engines for the turbocharged type of operation. The basic change in the design is the adoption of the enbloc type of construction with the removable power cylinder liners in place of the individual cylinders which characterized previous engines. (Figures 5 and 6). This has provided not only greater structural strength and rigidity but has made possible several features which contribute to the improved performance of the engine.

Perhaps most significant among these is the streamlining of the air and exhaust passages at the points of high-velocity approaching and leaving the ports of the cylinder liners. This is essential for maintaining a low pressure drop from blower discharge to turbine inlet. The importance of keeping this pressure drop low will readily be seen by drawing in a new line of "operating conditions" in Figure 2 parallel to, but above the existing line.

This construction also has made possible the location of the scavenging-air intercoolers just upstream of the cylinder ports — an individual cooling section for each cylinder. This location prevents any possibility of the air picking up heat from the engine parts after being cooled. The coolers also act as flame arresters, preventing the ignition of any fuel which might have penetrated into the induction system of the engine during a shutdown.

In general, bearing sizes have been increased considerably. In the 14 inch by 14 inch turbocharged engine, for example, main bearing area has been increased 22 percent, crankpin bearing area 9 percent, power piston wristpin area 20 percent, and compressor-cylinder crosshead-bushing area by 150 percent.

Conclusion. With the demand for natural gas as a fuel for both the American home and industry steadily increasing there has been a sharp upturn in the price of gas at the wellhead. The importance of the efficiency of the prime movers employed to move gas through our major gas-transmission pipe lines cannot be overemphasized.

The introduction of the turbocharged compressor with its attendant savings in fuel, cooling duty and over-all installation cost will undoubtedly prove to be an important contribution to the gas-transmission industry and others concerned with the procurement and distribution of natural gas. —The End

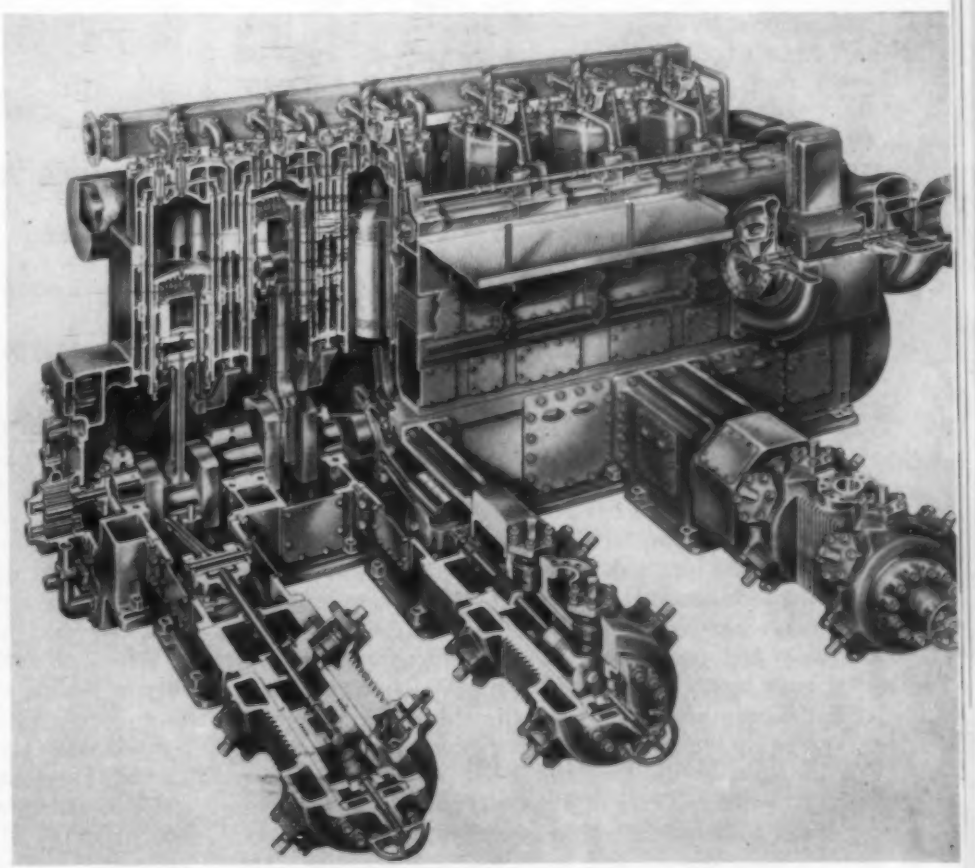


Fig. 6—Cutaway view of new engine.

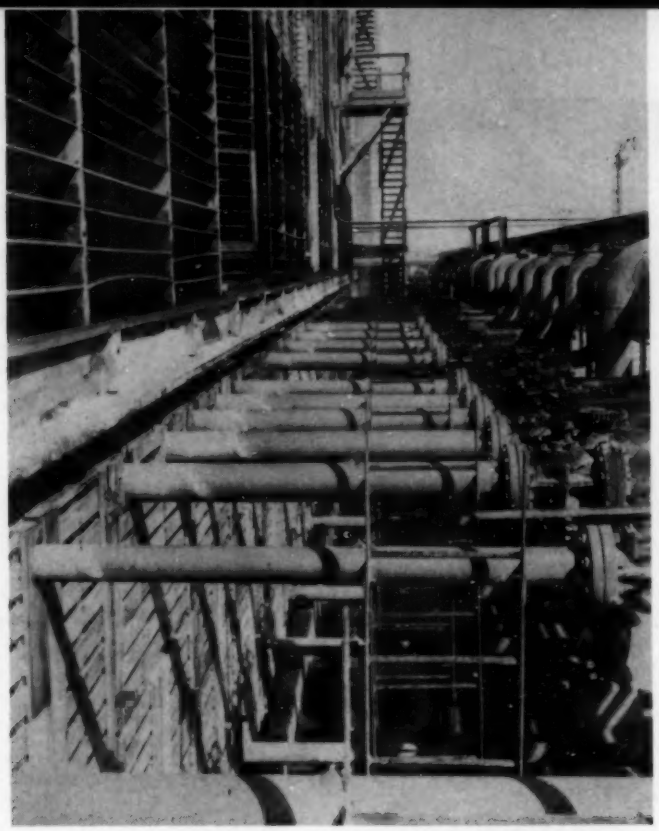


FIGURE 1

Coated pipe headers to cooling tower. Note white scale due to water spray and evaporation.

Coatings Will Protect Cooling Tower Headers

Epoxy resin and vinyl systems perform well during test. A set of definite specifications and constant supervision during application pay off.

By R. L. ELKINS and G. O. HULT,
Shell Oil Company, Midland, Texas

PROTECTIVE COATINGS, if applied properly and in sufficient film thicknesses, will control corrosion of piping headers to cooling towers. Shell Oil Company has reached this conclusion after extensive tests—tests that were commenced when atmospheric corrosion of these piping headers in gasoline plants showed up as a major problem. In applying such coatings, however, it is believed necessary to use comprehensive specifications together with good supervision and inspection. Greatly reduced maintenance costs have been chalked up as a result of this procedure.

The history of paint coatings in this service is one of short coating life and unsatisfactory corrosion protection. For example, at the time the TXL Gasoline Plant was built at Notrees, Texas in 1948, the headers to the cooling tower were coated with a system employing a primer, hot-applied coal tar, and asphalt paper wrapping. The severe operating conditions of high temperature, humid atmosphere, and water spray caused rapid failure of these coatings. Therefore, one year later, in 1949, the coatings were removed, the lines were sandblasted, and a four-coat system of vinyl resin paint applied. During the application of these coatings the tower remained in service and the lines were shielded from water spray with tarpaulins. Again relatively rapid coating failures occurred and corrosion proceeded at a fairly high rate.

When an addition was made to the plant in 1949 a second cooling tower was added and all headers to this tower were painted with a two-coat system of cold-applied coal tar. Once more rapid coating failures occurred. These and similar experiences in Shell's other two gasoline plants in West Texas indicated that the problem was of sufficient importance to merit a careful study of corrosive environments and possible control methods. Therefore, a thorough investigation was made in 1952

and it was decided that, in spite of the poor performance of previous coatings, the use of protective coatings was still the most promising method of preventing corrosion of headers in service.

Since the protection of replacement headers or headers in newly constructed towers is a problem which is quite different in many respects, the application of coatings may not be the most practical method of protecting them. Due to the hazardous conditions existing in the vicinity of the cooling towers, only the cold-applied coatings were considered suitable for coating headers in service; thus metallizing and other similarly applied coatings were excluded. In order to improve the performance of coatings applied to piping headers, it was concluded that better paints and application techniques were needed.

This investigation also indicated that the highest corrosion pitting rates generally occurred on the outlet headers. Apparently, moisture condensed and collected in droplets on the lower half of these lines and produced a deep pitting type corrosion, as shown in Figure 2.

FIGURE 2—Outlet piping header shows severe corrosion pitting.

When they were examined it was found that many of these headers in the TXL Plant's two cooling towers were pitted almost through their pipe wall even though they had been protected by coatings during a large part of their three and four years of service. Severe corrosion pitting also had occurred on many of the inlet headers where water ran off the cooling coils onto the line. Several inlet headers in the plant's older cooling tower were deeply pitted due to this cause after four years of service. Another cause of high corrosion rates was water spray which affected principally the lower inlet headers and a section of the upper outlet headers adjacent to the coil flanges, as shown in Figure 3.

In view of the need for improved paint performance, comprehensive specifications covering cleaning and application methods were prepared and during April 1953 the piping headers to the two cooling towers in the TXL Plant were again coated, this time with several types of paints in accordance with the specifications. Briefly, the specifications stated that:

(1) The contractor would furnish all supervision, labor, transportation, insurance, rigging, cleaning material, and sandblasting and coating equipment to perform in a workmanlike manner all cleaning and coating work in strict conformity with the specifications.

(2) Surfaces would be protected from all water spray during the process of sandblasting and subsequent application and drying of coatings.

(3) All surfaces to be coated would be thoroughly clean of rust, dirt, oil, grease, old paint and mill scale by sandblasting to a Class A white steel surface finish. Note: Class A white steel surface finish required the complete removal of all corrosion products, loose and tight mill scale and the gray oxide binder between the mill scale and steel, thus exposing the white metal.

(4) Sandblast sand would be dry, angular or sharp flint or silica abrasive type and would be properly graded (100 percent of which would pass a No. 10 mesh sieve and 95 percent of which would be retained on a No. 20 mesh sieve) and free of clay or other matter likely to become imbedded in the steel surface.

(5) The compressed air used in sandblasting would be free of oil and would have a sufficiently low moisture content to prevent condensation of moisture on the surfaces being cleaned.

(6) Prior to the formation of corrosion, all sandblasted surfaces would be cleaned dust-free by wiping with clean cloths, or vacuum cleaning, and immediately primed. Should the prepared surface become dirty or rusty before the prime coat was applied, the surface would be resandblasted.

(7) Where painting had commenced, the complete painting operation, including priming and finishing coats, would be completed as soon as possible. In no event, except delay due to weather conditions, would more time elapse between successive coatings than that necessary to render the coats thoroughly dry.

(8) In applying the coatings, the spray gun would be held not more than 6-8 inches from, and at right angles to, the work at all times. A wet-looking film that would flow, but not to the point of sagging, was desired. Air pressures on material pot and spray gun would be controlled to provide a uniformly wet film.

(9) The performance of work and the finished coating would be subject to inspection by an agent of Shell and additional coatings would be applied, if necessary, to all areas where vinyl or epoxy resin paint films were less than 5 mils, or phenolic resin paint films were less than 20 mils thick.

Competitive bids were obtained and the low bidder performed the work. The headers were shielded from water spray with tarpaulins and corrugated metal during the course of cleaning and painting, and the work was performed while the tower was in operation. Shell's plant engineers inspected and made certain that the performance of work and the quality of the finished coatings met specifications.

In this coatings test a five-coat vinyl resin system, employing a primer and four top coats, was applied to 47 outlet lines and 46 inlet lines with operating temperatures ranging from 80 to 150 F. For comparative purposes some of these systems utilized a wash primer and others used a red lead primer. However, comparisons to date have not revealed any noticeable superiority of one primer over the other. In addition to vinyl, a four-coat epoxy ester resin system, employing a red lead primer and three top coats, was applied to 27 outlet lines and 27 inlet lines operating at temperatures from 80 to 240 F. Both the vinyl and epoxy paints were spray-applied without reducing the normal operating temperatures of the lines, and no paint blistering or other difficulty was encountered. This was of interest in view of the fact that four of the lines coated with vinyl paint had operating temperatures as high as 150 F., and eight lines coated with epoxy paint had temperatures of 240 F. Measurements of the completed paint systems showed that a minimum dry film thickness of 5 mils had been obtained with both the five-coat vinyl and the four-coat epoxy systems.

In addition to these tests, a three coat system of an amine-cured, modified phenolic resin paint was brush-

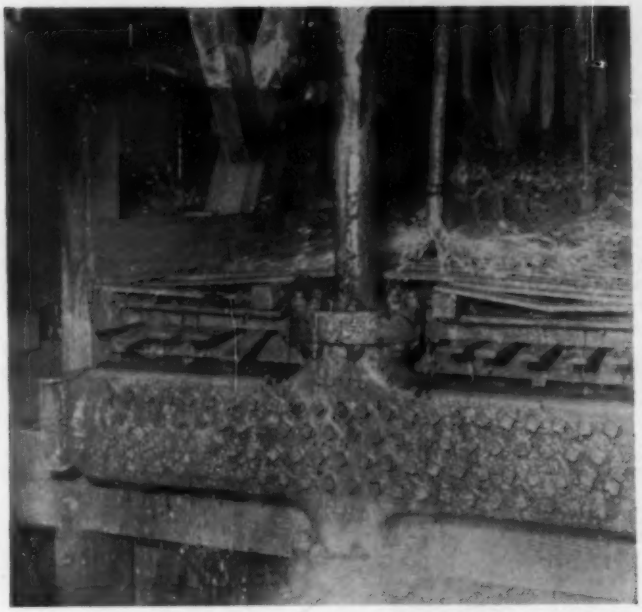


FIGURE 3—Coated outlet header shows paint blistering adjacent to cooling coil flange due to water spray.

FIGURE 4—Splash zone on outlet and inlet headers. Coatings are still in good condition.

applied to two outlet and four inlet lines with operating temperatures from 80 to 240 F. This system consisted of a primer, containing powdered mica, and two top coats. An attempt was made to apply the paint to the hot lines; however, brushing difficulties demanded that they be cooled during the painting process. Measurements of the coated lines indicated that a minimum film thickness of 30 mils had been obtained.

During the two years since the headers were coated they have been examined periodically and few coating failures have been observed. The coatings on almost all of the outlet headers, where the corrosion problem was most severe, are still in excellent condition. For example, coating failures have occurred on only seven of the 76 outlet headers. In every case these failures were adjacent to the cooling coil flange and had been caused by severe water spray, as shown in Figures 3 and 4. Failure consisted of only a few small coating breaks per line. Coating failures on the inlet headers have been more numerous, occurring on 21 of the 77 lines. However, extensive failures have occurred on only two of these 21 lines, while the remaining 19 contain but a few small coating breaks per line. Blistered paint coatings on inlet lines are shown in Figure 5. Here again failures were attributed to severe water spray. In an effort to protect the paint coatings, water spray on headers was reduced, or eliminated, where possible, and this practice seems to have been very beneficial in prolonging the service life of the coatings.

Comparisons of vinyl and epoxy resin coatings to date have revealed no significant differences in their performance. The epoxy paints have performed very well on 240 F. lines where the vinyl paints likely would have failed rapidly. The top coat has peeled in places on these high temperature lines coated with epoxy; however, the three remaining coats are intact and providing protection.

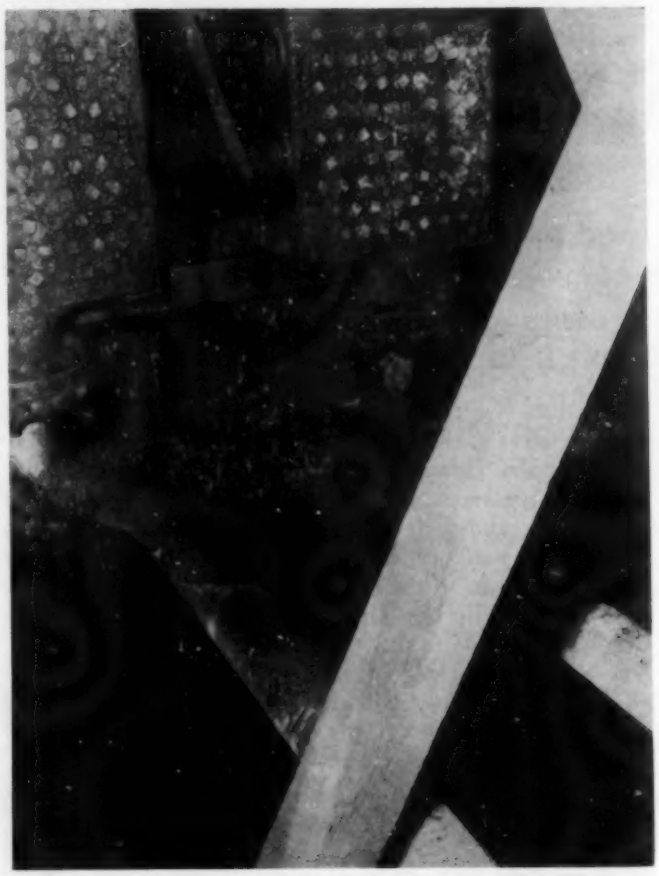


FIGURE 5—Coated inlet headers show paint blistering due to severe water spray.

Since this has not occurred on any of the cool lines, the peeling is believed to have resulted because the high temperature caused rapid paint drying, and too much time elapsed between the application of the third and fourth coatings. For these reasons the paint dried to a hard

finish and poor adhesion between these coatings resulted. So far the epoxy systems have shown an economic advantage due to the fact that 5 mils minimum film thickness was obtained with four coats of epoxy paint whereas five coats of vinyl were required. In addition, somewhat greater coverage was obtained with the epoxy paints, as shown in Table 1. For these reasons the epoxy systems required less material and labor which was reflected in their cost of $0.65 per square foot versus $0.81 for the vinyl systems.

The modified phenolic coatings are still in excellent condition and appear to be particularly well suited for use on the high temperature lines. These coatings on four 240 F. inlet lines have exhibited no blistering, peeling or checking even though they have been subjected to heat, water spray, and severe scaling conditions. The scaling condition is very destructive to coatings because the scale continually cracks off and tends to remove the coating in the process. Figure 6 illustrates the type of scale accumulation on these lines. As shown in Table 1, the phenolic coatings cost $1.11 per square foot, or almost twice that of the vinyl or epoxy coatings. However, it appears that this higher cost will be justified in instances where high temerature and severe water spray are encountered.

Cost analyses which have been made indicate that substantial savings will be effected by these protective coatings. For example, it was estimated that the average life of unprotected piping headers to the TXL Plant's two cooling towers would be about four years. This was based on the findings of severe corrosion damage to many of the headers after three years service, a large portion of which time they had been protected. Assuming an average four-year life, the annual cost of replacing piping headers to the two towers would be about $5600 per year. In contrast, it cost $3030 to coat all of these headers. If the epoxy and vinyl resin coatings last three years and the phenolic resin coatings last four years, which appears very likely, the yearly cost of protection will be $990, or only 18 percent of the cost of uncontrolled corrosion.

In summary, the performance of the test coatings is much improved over that previously obtained, and this improvement is attributed to the use of definite specifications. It is believed that even better performance might be obtained from coatings applied in the future by using the knowledge obtained from these tests, by requiring more strict conformity to specifications, and by minimizing water spray on coated headers. In view of the results to date it appears that protective coatings, if applied properly and in sufficient film thicknesses, can be employed to control corrosion of piping headers to cooling towers, and thereby greatly reduce maintenance expense. In order to assure the quality of the coatings, it is believed necessary to use written, comprehensive specifications together with good supervision and inspection when applying paints in such corrosive environments as found in cooling towers. Finally, if headers are painted, steps should be taken to reduce, or eliminate, water spray on them since this procedure will greatly lengthen the life of the coatings.

TABLE 1

Costs of Epoxy Ester, Vinyl, and Modified Phenolic Resin Paint Systems

PAINT RESIN	No. of Coats	Coverage (Ft.²/Gal.)	Materials Cost ($/Ft.²)	Labor Cost Cleaning & Coating ($/Ft.²)	Total Cost of Coating System ($/Ft.²)
Epoxy	4	193	0.168	0.482	$0.65
Vinyl	5	150	0.267	0.543	$0.81
Phenolic	3	117	0.684	0.423	$1.11

FIGURE 6—High temperature inlet headers show heavy accumulation of scale.

ACKNOWLEDGMENT

Original presentation was before the annual meeting of NGAA, April 13-15, 1955, Dallas.

About the Authors

R. L. ELKINS is area corrosion engineer for Shell Oil Company at Midland, Texas. A chemical engineering graduate from Texas A&M College, he joined the company in 1947, working on corrosion and related problems in production operations, first in Kansas and later in West Texas. He is active in NACE, and serves as vice chairman of the technical committee's concerned with sour oil wells, oil string casing, crude oil lines and tanks.

G. O. HULT, who is Shell's gas engineer at Midland, joined the company in 1936. After a three-year assignment in Oklahoma, he was transferred to Houston, where he stayed until 1951 when he was appointed to his present position as gas engineer for the Midland area. Hult holds a B.S. degree in chemical engineering from the University of Nebraska.

1 Down into the water-filled ditch and through the marsh goes some 6 million pounds of concrete-coated 20-inch pipe. Each 40-foot joint of pipe weighed approximately 9500 pounds in the air and four empty oil drums provided just enough buoyancy to support each joint in the water. The winch tractor at the left helps start the pipe on its way.

3 The pipe was four-jointed in the pipe yard at shovepoint. It had been coated previously by Rosson Richards with 2⅛ inches of concrete, bringing the .375 wall pipe to a total weight of 239 pounds per lineal foot.

4 TGT Engineer D. J. Berard tallies the length of the four-jointed sections before they were welded into the line and launched. Two tractors in background maneuvered pipe into position for welding.

2 And four miles away, the end of the pipe moves through the water in 160-foot shoves. The biggest risk in this type of operation is that the drums will spring leaks and let the pipe sag to the bottom of the ditch. The powerful shove can cause the pipe to buckle when this happens.

Drums Buoy 6 Million Pounds of Pipe Line

As much as 31,000 feet at a time of 20-inch concrete-coated pipe was shoved through the marshes in constructing TGT's south Louisiana line from Kinder to Pecan Island.

By DONALD M. TAYLOR, Editor, PIPE LINE INDUSTRY

YOU NEVER KNOW where an empty 55-gallon oil drum will pop up next. During two wars, service men have made them into ovens, rafts, sailing crafts and even wind-driven washing machines. The drums have been converted into refrigerators, tool chests, and barbeque pits.

But their most successful role (aside from their original purposes as a container) perhaps has been in the field

5 Four drums were banded to each 40-foot length of pipe with metal box straps. After the line is in place, they are removed and retrieved for further use. The wire rope hitch around the pipe is used for stopping the pipe after it has moved 160 feet. Should the 5 or 6 million pounds of pipe not be halted in time, the open end of the pipe would enter water, meaning trouble.

6 Weld is being completed here and three tractors are poised to start pipe on its journey. Longest section of line shoved on project was 31,000 feet.

7 A new wrinkle was added when pipe line enamel was poured over the exposed fresh concrete in the field mold to protect it from the water.

8 Four barges lashed together were used to lay the pipe across the lakes and down canals. Many of them were dredged for this purpose.

of marine pipelining. They have been used as pontoons to launch pipe lines into the ocean and across marshes and swamps. Houston Contracting Company recently used thousands of them to launch 4- and 5-mile lengths of heavy, concrete-coated 20-inch pipe line across marshes in south Louisiana for Tennessee Gas Transmission Company.

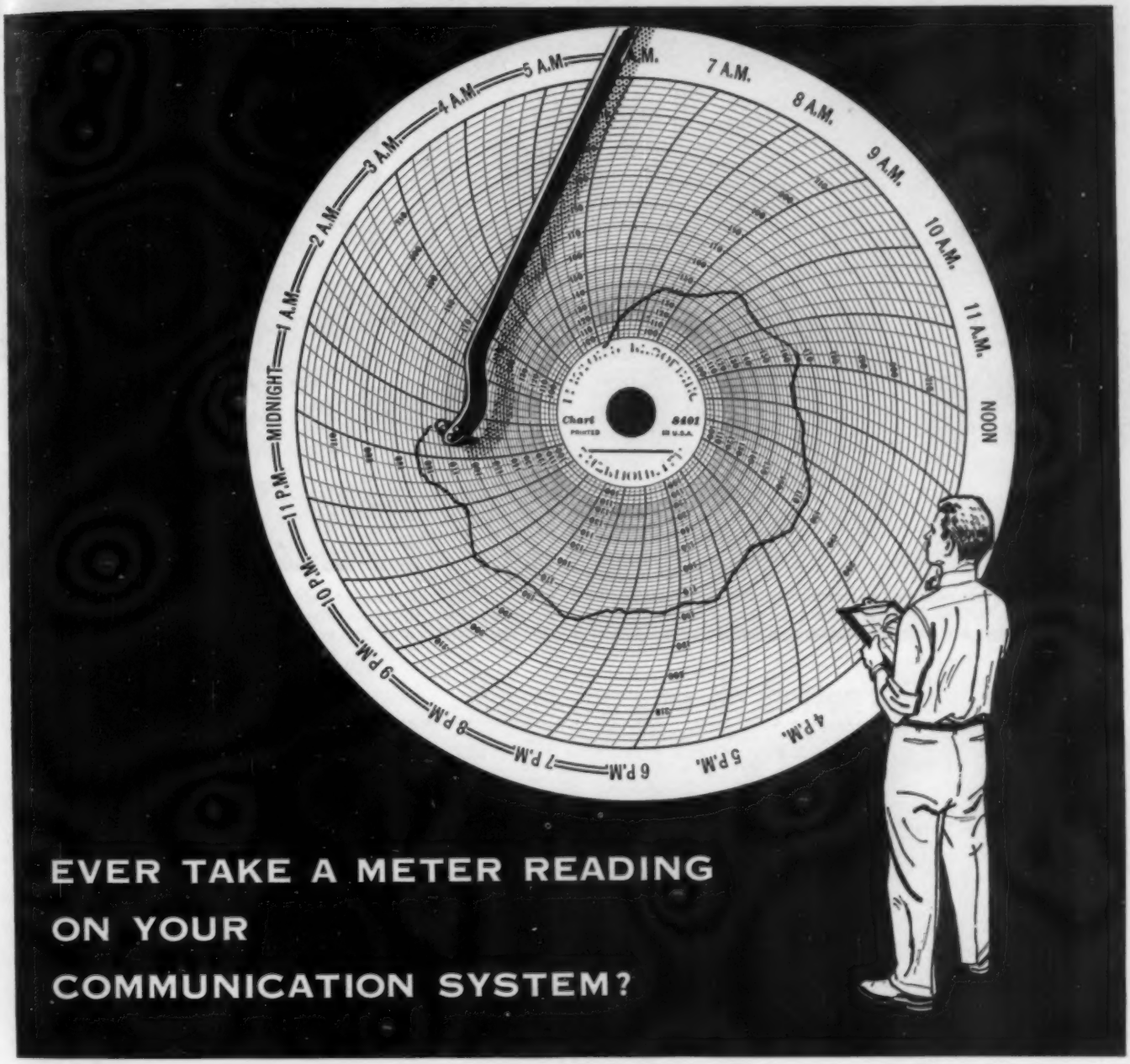
The new line, being laid from Kinder to Pecan Island, La., will lie under water for the most part. Where it crosses lakes and large marshes, big enough to justify a considerable outlay of marine equipment, the contractor laid the line from barges. But other sections of the line, were shoved from high spots along the water saturated right-of-way as shown here.

Stovepiping two single joints at a time . . .

Houston Contracting Company double-stovepiped the line into the canals and lakes of South Louisiana from four barges coupled together. By adding two single joints at a time to the line, the contractor was able to utilize six work stations, the first two for line-up stringer bead and hot pass, the second two stations for welding, and the third pair for coating and field molds.

Two tractors and one dragline operating on the four coupled barges kept the pipe going into the water at about 4000 feet per 24-hour day.

Continued on Page 62



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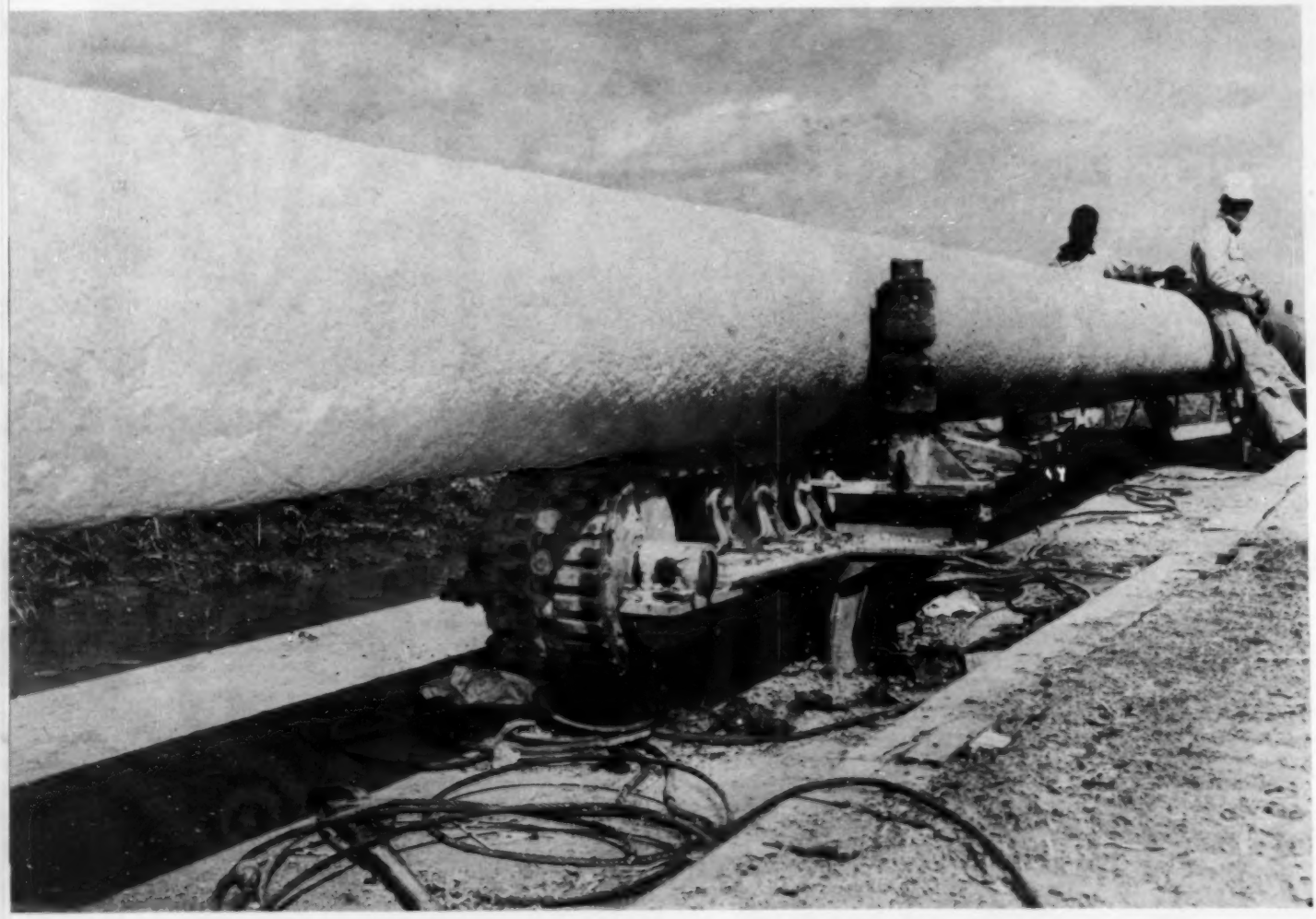
9 Six work stations were used to stovepipe the line, two single joints at a time. The two joints were lined up one behind the other. Two crews of welders made simultaneous stringer beads and hot passes while two additional crews of welders finished on two previous joints of pipe. Two crews added coating and field mold at final two stations. Pipe went into water 80 feet at a time.

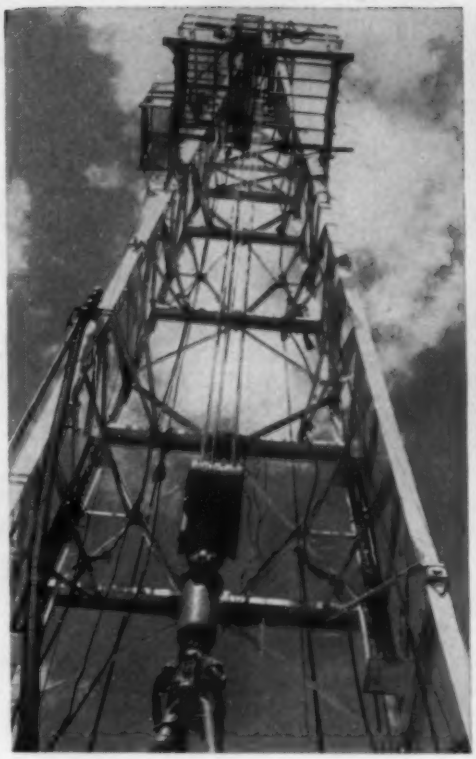


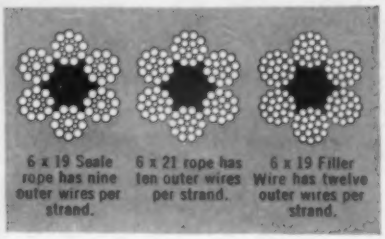
10 Rubber-clad tracks supported pipe on barge. They were made from war surplus half-tracks.

Key men on the north spread. Left to right: Carl Viola, TGT's district pipe line superintendent at Natchitoches, La. He served as inspector on the northern half of line. F. A. (Mizzoo) Silar, spread superintendent, Houston Contracting Company, and R. L. Silar, assistant spread superintendent.

On a two-hour speedboat ride to the job are Leonard Robinson (left), TGT district pipe line superintendent at Kinder, La., and chief inspector of the south spread, and Earl Norris, Houston Contracting Company superintendent on south spread. This spread worked 24 hours a day.

—The End




6 x 19 Seale rope has nine outer wires per strand.
6 x 21 rope has ten outer wires per strand.
6 x 19 Filler Wire has twelve outer wires per strand.

What can you do better with 6x21 *Red-Strand* wire rope?

What is 6 x 21 wire rope? It is sometimes called 6 x 16 Filler Wire. It is a construction of intermediate flexibility—between coarse 6 x 19 Seale and flexible 6 x 19 Filler Wire. 6 x 21 is a good choice where the operation includes abrasion and at the same time the rope is subjected to considerable bending. On certain types of duty the choice is vital to save time, effort and money.

When to use it? If, for example, your 6 x 19 Filler Wire rope is wearing out too soon because of abrasion, 6 x 21 with larger outer wires may provide much longer life. If severe bending is damaging your 6 x 19 Seale, a change to more flexible 6 x 21 may be profitable.

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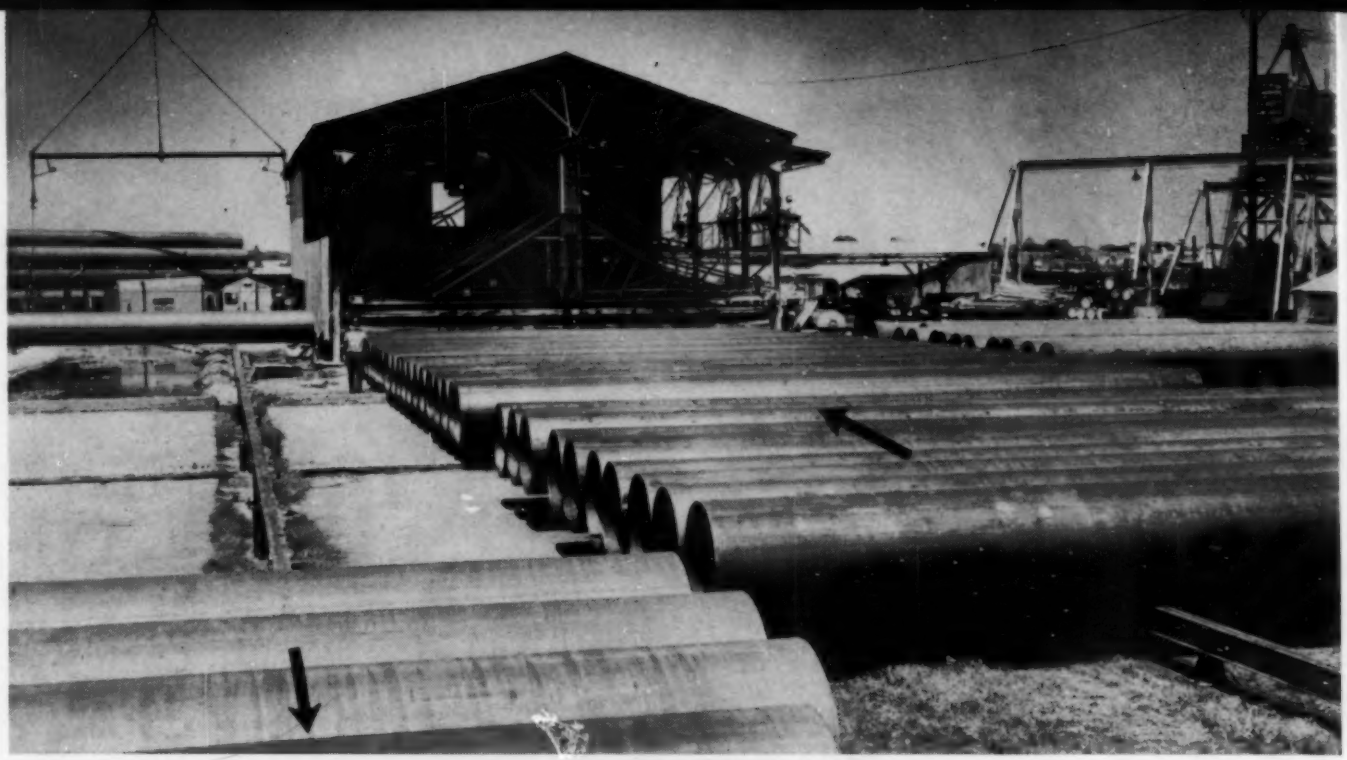


1 Pipe at right rolls from the mill to the plant where it is cleaned, pickled, and coated internally with epoxy resin. Coated length of pipe at left rolls down rails to shipping rack.

How 36-Inch Pipe Is Pickled and Coated

Transco's pipe for $83 million looping project is cleaned, pickled and coated internally with epoxy resin at is comes from the mill.

By **MELVIN A. JUDAH,** PIPE LINE INDUSTRY Staff

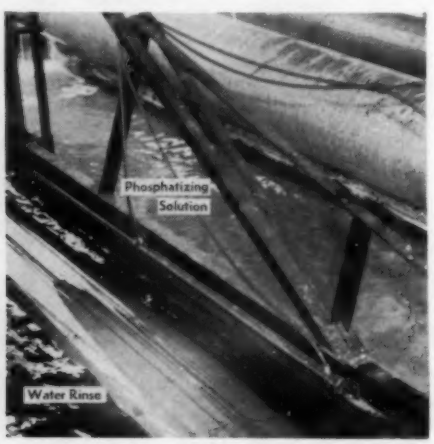
MORE THAN 200 miles of the 30 and 36-inch pipe which will be used in Transcontinental Gas Pipe Line Corporation's $83 million looping program is being pickled and internally coated with epoxy resin. (March PIPE LINE INDUSTRY, page 40.)

As the joints of 36-inch pipe come from the mill at Orange, Texas, they are rolled to Rosson-Richard's plant nearby. Here, the pipe is cleaned by a hot alkaline bath, an acid bath, and treated with a phosphatizing solution. It is then sprayed internally with epoxy resin and loaded on flat cars.

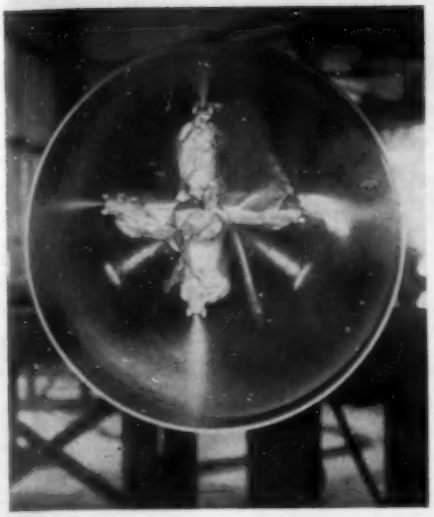
Photographs on these pages show the step-by-step pickling process. Two minutes in the alkaline bath removes oily film and dirt. After a fresh water rinse, scale and oxides are removed in the sulfuric acid pickling bath. Four

2 Pipe is given hot alkali wash (left) then a fresh-water rinse (right).

3 Sulfuric acid wash removes all mill scale and oxides from the pipe.



4 Pipe then gets a fresh-water rinse and phosphatizing treatment.



5 Epoxy resin is sprayed on the inside of spinning pipe by a four-nozzle sprayer on the end of moving horizontal boom.

sections are pickled at once. The vat bottom is slanted and pipe rolls to the deep end in seven minutes. It is then rinsed and given a three-minute bath in the 180° F. phosphatizing solution.

Pipe dries on the way to the coating station where epoxy resin, together with amine curing agent, is sprayed on the inside.

The epoxy resin coating promises several advantages over bare pipe. Time and cost of running pigs to clean line after hydrostatic testing should be cut. Corrosion during storage will be virtually eliminated and friction factor should be improved. Finished lines will be cleaner, reducing the need for scrubbers to handle mill scale.

6 Nozzle drawn from pipe at far end. Inside is coated with continuous film of epoxy resin approximately 1½ mils thick.

Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

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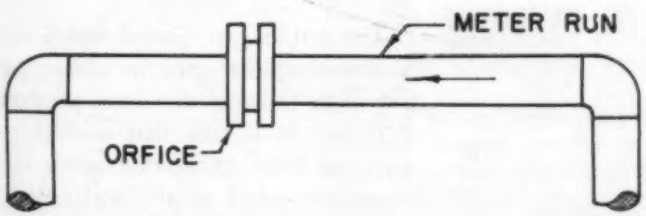
These formulae from the pages of engineers' own notebooks yield rough, but reasonably accurate answers for design, maintenance and supply questions. The Editors will pay $15 for your pet Rule of Thumb. Send your Rule of Thumb to Donald M. Taylor, Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1.

Engineering Design

—23—How to size a gas metering run.



Multiply the absolute pressure by the desired differential pressure (the differential in inches of water should not be greater than the absolute pressure in psia). Take the square root of the product. Divide this figure into the maximum flow rate in cubic feet per hour to obtain the approximate coefficient. Then divide the maximum coefficient by 250 and take the square root to determine the approximate inside diameter of the orifice in inches. The metering run diameter should not be less than one-third larger than the orifice diameter.

Example: Find the orifice diameter and meter run for a line designed to carry a maximum flow of 2 Mmcf per hour at a pressure of 600 psia. Use a differential pressure of 50 inches of water.

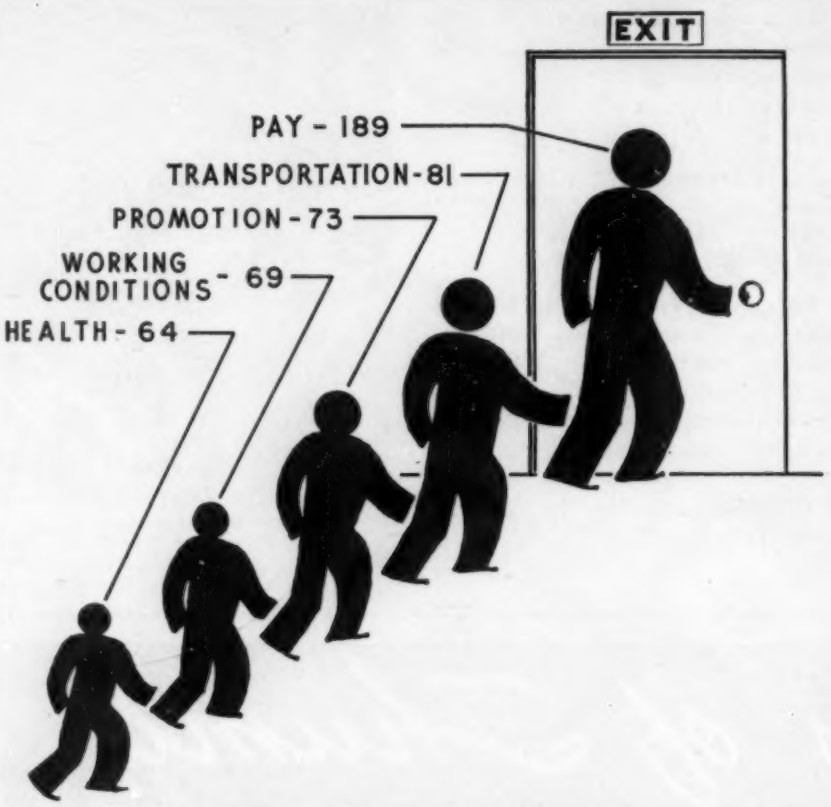
$$\sqrt{600 \times 50} = \sqrt{30{,}000} = 173.2$$

$$\frac{2{,}000{,}000}{173.2} = 11{,}540$$

$$\frac{11{,}540}{250} = 46.2$$

$\sqrt{46.2}$ = 6.8 inches, approximate orifice diameter

Meter run should not be less than ten inches in diameter.



IT'S NOT SO SIMPLE AS THIS. When asked why they quit their jobs, 189 out of 500 employes said the pay was unsatisfactory, and 81 blamed transportation difficulties. But tedious research revealed some interlocking grievances which indicate that many employes really don't know why they quit.

Here's Why Employes Quit

It costs a company $80 to $600 every time a worker quits. Here is a scientific analysis of the WHY of separations in 48 companies.

By DR. WILLARD A. KERR, Illinois Institute of Technology, Chicago

IT COSTS YOUR company from $80 to $600 every time an employe quits.

The existence of this turnover is readily apparent on any firm's books; but the causes for the turnovers remain hidden until many tedious hours of research determine that the most important is pay.

The problem was approached by going directly to the "turnovers" themselves and to exit interviewers, who are in a uniquely favorable position to observe the dynamics of the turnover process. Exit interviewers in 48 companies which report 5075 quitting cases yearly cooperated in reporting the relative frequency with which various matters are brought up in the exit interview.

Based on these findings, the study inter-related all the complaints in order to establish typical grievance patterns of quitting personnel.

What Quitters Complain About—Per five typical exit interviews, the pay rate was complained about almost twice, which was more often than any other topic (1.89 times out of 5.00). Other topics, in rank order of mention per five interviews included transportation (0.81), promotion (0.73), working conditions (0.69), poor health (0.64), job security (0.54), friction with co-workers (0.52), poor housing or excessive rents (0.50—that is, once in ten interviews), personal happiness as affected by job experience (0.33), broken promises by supervisor (0.25), confidence in management (0.19), company interest in welfare of employes (0.15), freedom of communication with higher levels (0.12), recreation (0.04), method of wage payment (0.02), other problems (1.15).

Comparison of Exit Complaints—Most of the above topics are included in a widely used job satisfaction survey form employed on non-quitting personnel. When some typical non-quitter data were compared with these exit interview content data, it was found that pay was the foremost grievance in both. Working conditions also was a major grievance in both. Among other topics, however, the agreement was moderate or low.

The results just quoted which emphasize employe concern about pay may seem to contradict some previous evidence. It is true that several researchers have found that when employes are asked what they consider "most important" in their jobs, they *do not* put pay as foremost in importance. Actually, such results are not in contradiction to the job satisfaction survey and exit interview results, because the "importance ranking" studies represent research on an entirely different variable. "Factor importance in a job" is not the same thing as

Presenting

OFFSHORE

PIPE LINE

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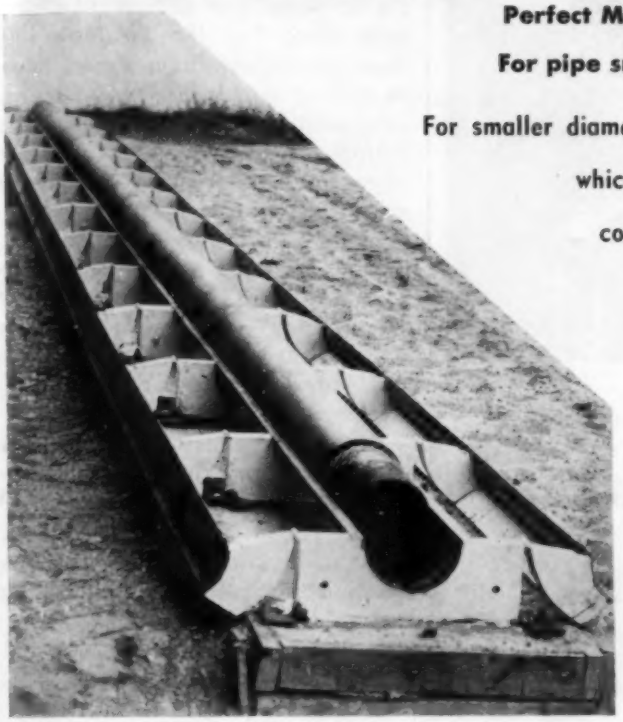
Perfect Marine Protection

For pipe smaller than 10"



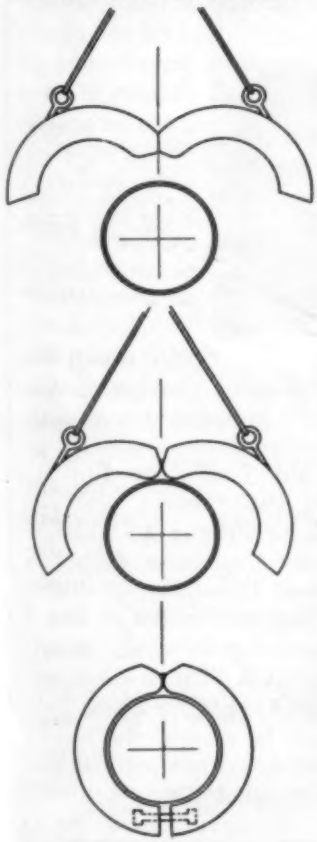
For smaller diameter pipe and for offshore work, we use a new type form in which the pipe is rotated and concrete is poured in from the top. This concrete coating is also reinforced with wire mesh which remains in the approximate center of the coating. By using this method we obtain a smooth even coat and the wire can be left extruding from each end to facilitate applying field joints.

Left: Specially designed form.

Right: Note wire mesh in coating.

Roto-Cote Pat. Ser. No. 469722

CONCRETE RIVER WEIGHTS



ANCHOR-WATES

ANCHOR-WATES OF THE "BOLT-ON TYPE" are designed with T-type slots for fast alignment of the two halves on the pipe. They can be furnished with a variety of methods for bolting halves together based on service and customer requirements. They are made with extra thick, well reinforced slots to decrease breakage. The concrete weights furnished by this company are made to meet the highest standards of the industry, quality products of quality materials manufactured under careful supervision.

HOW HINGED WATES WORK:

The two halves of the concrete Wate are hinged together with wire cable line embedded in the concrete when the "Wates" are cast. When picked up with a tractor side boom, the halves open wide so that they can be lowered onto the pipeline without difficulty.

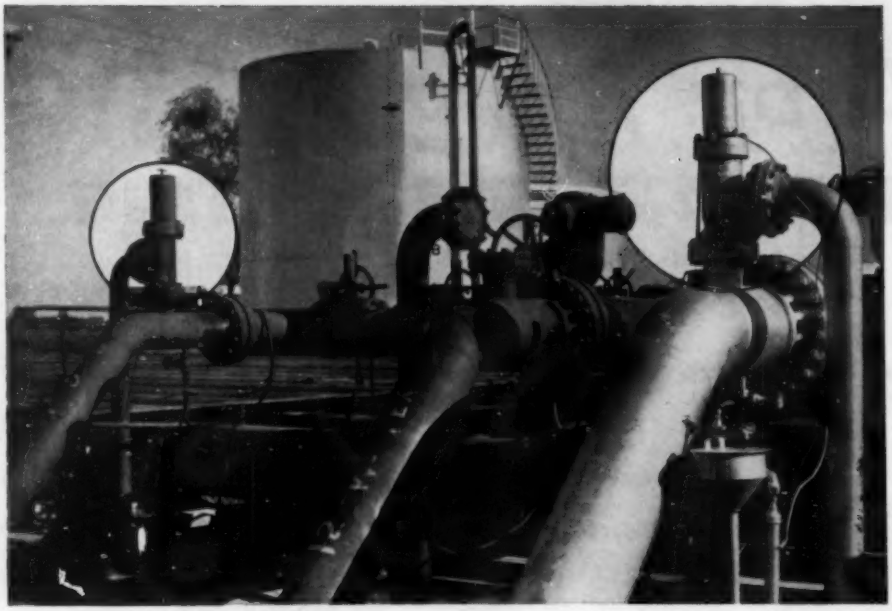
"Hinged Wates" eliminate the time and trouble of placing two halves of ordinary concrete weights on the top and bottom of the line, eliminate the numerous bolts required to hold them together on the pipe.

When the "Wate" comes to rest on the pipe, the two halves automatically fold around it until they are in position to put the bolts in place that holds them securely on the pipe.

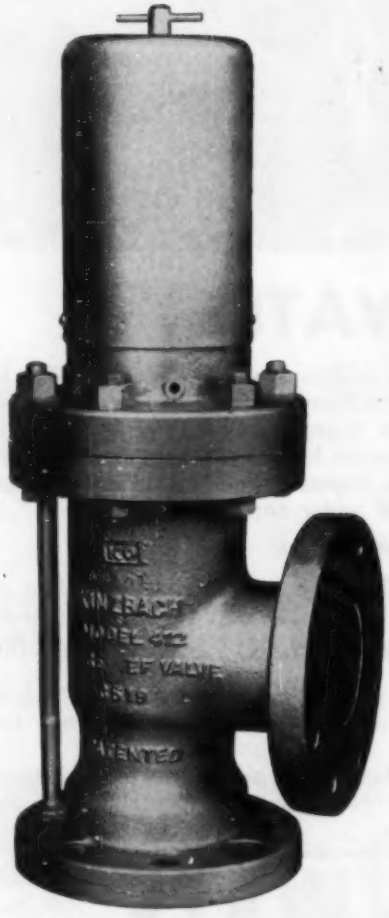
ANCHOR **WATE**

U.S. PAT. OFF. Ser. No. 413031
Canadian PAT. OFF. Ser. No. 681275

P. O. BOX 12185 PHONE: MI 9-2769 HOUSTON 17, TEXAS
13308 Telephone Road



Positive Protection Against Pressure Surges



KINZBACH
MODEL 412
RELIEF VALVE
for Pipelines and Refineries

When a pressure overload in the line is reached, the Kinzbach Model 412 Relief Valve opens instantly to full capacity. This valve provides automatic resetting at a pre-determined pressure drop, positive seating and facilities for functional testing.

The Model 412 uses line pressure for opening and closing. The opening pressure is preset by application of a dead weight load. Opening and closing action is positive and reliable. The pre-set pressure never changes.

Kinzbach Model 412 Relief Valves are available in 2", 3", 4", 6" and 8" sizes for working pressures up to 1000 p.s.i. Write for Bulletin RV412 for full technical data.

KINZBACH TOOL CO INC

KINZBACH TOOL COMPANY, INC.

P. O. Box 277 Houston, Texas

Export Office: 74 Trinity Place, New York, N. Y.

what the employe is happy or unhappy about in a job. The factor importance ranking studies referred to above are cast in an abstract, theoretical frame of reference for the employe respondent. They get at his set of philosophical values. But the job satisfaction survey and exit interview get at something different: *not the importance but the satisfactory or unsatisfactory condition of each factor in current work experience.* Generalizing from all these related researches, it might be suggested that employes in general concede that pay is not the most important factor in a job, but they nevertheless feel that it represents a foremost grievance factor. This generalization is bolstered by the RCA Victor study which showed that the departments with the highest turnover had lower average pay than other units.

Eight companies cooperated in making a comparison of exit complaints with complaints made in routine personnel counselling. The relative ranking of topics in order of complaint frequency was similar to the ranking obtained on quitting per-

About the Author

WILLARD A. KERR, in addition to teaching a full load of industrial psychology courses to engineering students at Illinois Institute of Technology, maintains a continuous and unsubsidized program of research in human-relations problems. Author of 67 published researches, Dr. Kerr, an associate professor, joined the faculty at Illinois Tech in 1947, after a year as assistant professor at Tulane University. A graduate of Southern Illinois University, he completed graduate studies at Purdue University in 1942. After directing RCA Victor's war-time industrial music program for two years, he entered the Navy where he served two years as an aviation psychologist.

For more data on advertised products, use Readers' Service Cards, last page.

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Youngstown has 28 district sales offices conveniently located throughout the nation to serve you quickly. They are staffed with men who know the steel business thoroughly and are qualified to help you with your steel requirements. You can get quick service whether you write, wire or phone your nearby Youngstown District Sales Office.

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Chicago 2, Illinois
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Phone Franklin 2-5470

Cincinnati 2, Ohio
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Phone Main 1424

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2400 Terminal Tower Bldg.
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Columbus 15, Ohio
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Dallas 2, Texas
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Phone Riverside 9538

Denver 2, Colorado
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Phone Main 3-2283

Des Moines 9, Iowa
437 Insurance Exchange Bldg.
Phone 3-1265

Detroit 2, Michigan
926 Fisher Bldg.
Phone Trinity 5-5816

Grand Rapids 2, Michigan
604 Michigan Nat'l. Bank Bldg.
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Houston 2, Texas
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520 Circle Tower
Phone Melrose 2-3461

Kansas City 6, Mo.
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Los Angeles 15, Calif.
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Phone Prospect 7581

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Phone Broadway 1-5148

Minneapolis 2, Minn.
1050 Baker Bldg.
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New Orleans 12, La.
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500 Fifth Avenue
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San Francisco 5, Calif.
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Phone Garfield 1-6544

Seattle 4, Washington
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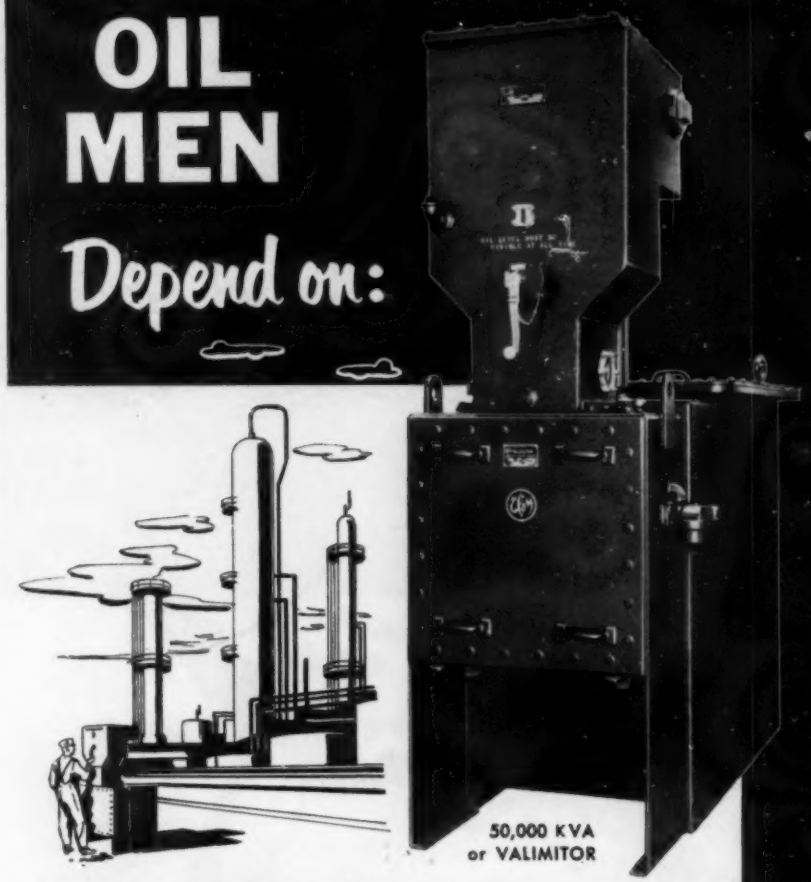
For more data on advertised products, use Readers' Service Cards, last page.

OIL MEN Depend on:



EC&M 2200-5000 VOLT Motor Starters

These EC&M Division 1 combination Starters for Class I, Group D hazardous locations give petroleum men top-value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and interrupting capacity is high . . . either 50,000KVA or in the VALIMITOR (volt-ampere-limitor) type, unlimited short circuit protection.

Oil disconnect switch (on top) may be locked open or closed, and has view windows on both sides to show switch contacts. Overload Relays of THERMAL-MAGNETIC type (mounted in conduit connection box) give accurate motor protection . . . trip instantly on faults.

Rear oil-tank has potential transformer for 220-volt push button circuit. 50,000 KVA type ZHS Magnetic Contactor may be inspected without disconnecting any bolts or leads. Contacts are copper tungsten alloy. VALIMITOR Starters, with air-core current-limiting reactors in rear tank, limit fault current to 25,000 KVA . . . ZHS Contactor clears circuit quickly. No fuses, no need to figure short possibilities . . . supply bus can be infinite KVA.

Before buying, investigate EC&M Combination Starters . . .they provide economy in installation, operation and maintenance . . . and they're complete in every respect.

1915

Write for 16-page Booklet 1062 on EC&M 2200-5000 volt starters.

THE ELECTRIC CONTROLLER & MFG. CO.

4495 LEE ROAD, CLEVELAND 28, OHIO

sonnel. This clearly suggests that the emotional content obtained from quitters may be a good barometer of grievances which are "pent up" but nevertheless existing in the non-quitting personnel.

But the most interesting findings of this research lie in the discovery of definite pattern structure of grievances.

Pattern Structure—Simultaneous mention of two or more topics of grievance was studied in order to attempt to discover which grievances tend to go together, that is, to accompany each other. Final results of this rather complicated statistical analysis are shown simply and graphically in Figure 1.

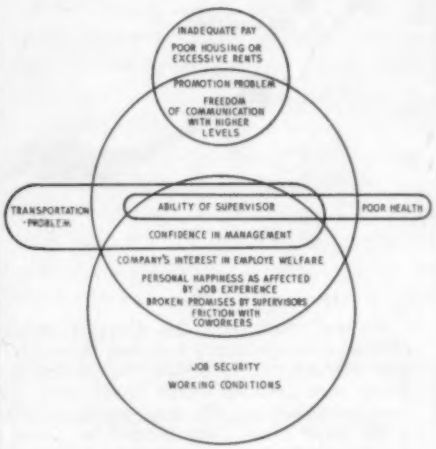
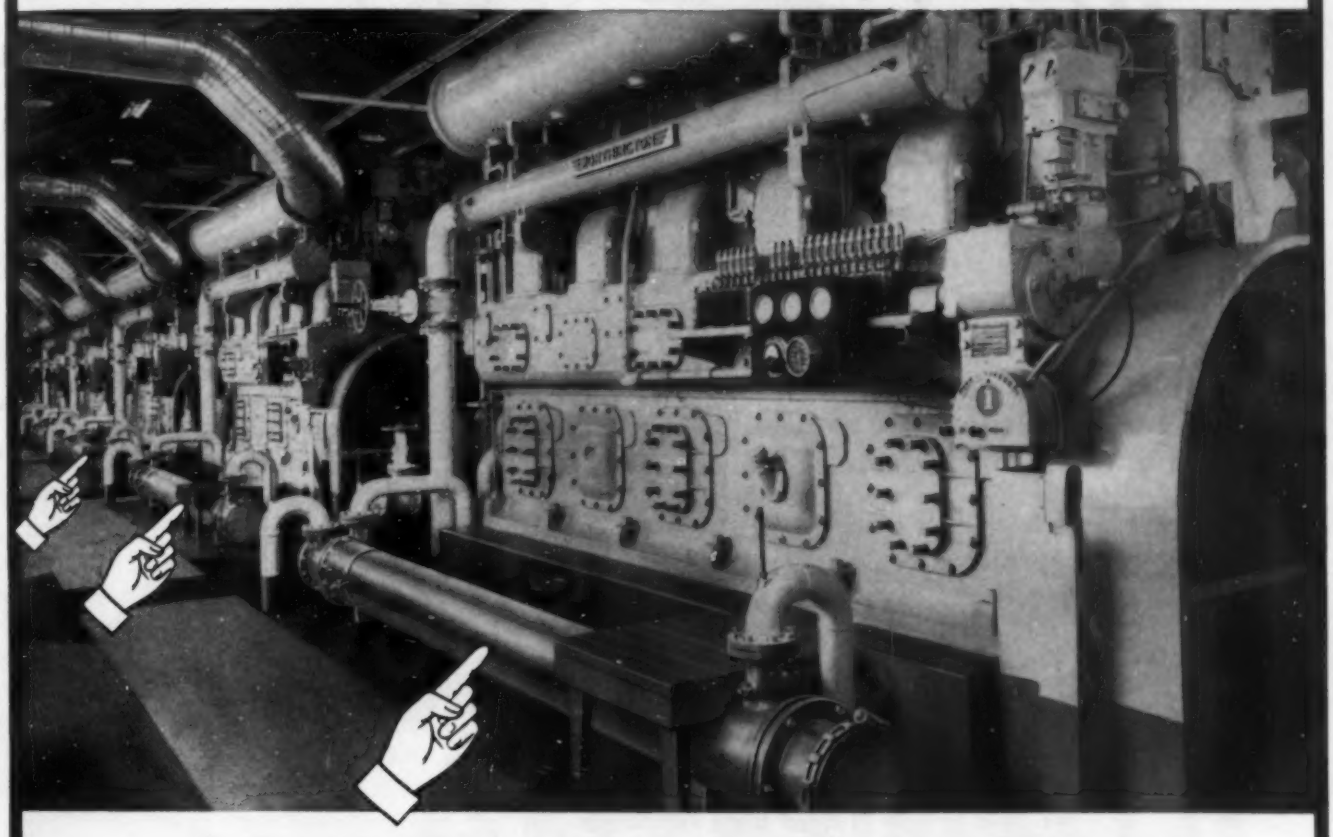


Figure 1. Motivations for quitting are woven in a complicated pattern.

Perhaps the most conspicuous single outcome of the analysis is the presence in four of the five patterns of "ability of the supervisor." Even "poor health," which correlates with nothing else as a reason for quitting is related with (lack of) "ability of supervisor." The question of whether the supervisor is a convenient scapegoat for the employe in poor health or whether he bears a causal psychosomatic relationship to employe poor health is not clear, but probably both tendencies operate. The triad in which the supervisor also figures along with "transportation" grievances and lack of "confidence in management" suggests an interesting pattern in some companies. It appears probable that employes far away from the plant have more transportation difficulties and therefore are tardy or absent more frequently than other personnel. The supervisor (of this pattern) categorizes mentally and orients to these employes as being of the "less dependable,

For more data on advertised products, use Readers' Service Cards, last page.

cooling the lube oil for 10 Worthington Compressors on this 423-mile gas pipeline



...ROSS EXCHANGERS

Moving 167,000,000 cu. ft. of gas per day through a 423-mile, 24-inch line is the job assigned El Paso Natural Gas Company's Navajo Station. Carrying the load are 10 Worthington Uniflo UTC-165 Gas Engine-Compressors with a combined rating of 7900 hp at this elevation of 6800 ft.

In virtually continuous operation — bearings, valve gear, pistons, power and compressor cylinders must receive constantly an ample supply of properly cooled lube oil. *And they do!* Each of the Worthington units is served by a Ross Type CP Exchanger. Safe, dependable cooling is assured at all times.

Top-rated for both thermal efficiency and ruggedness, Ross Exchangers work side-by-side with numerous types and makes of prime equipment in the oil and gas industry . . . in fact, in *every industry* . . . to cool lube oil, jacket water and hydraulic fluid.

Pre-engineered and fully standardized Ross Type CP Exchangers are assembled from mass produced parts and sub-assemblies to fulfill individual requirements — *promptly.*

More information is in Bulletin 2.1K1. Write.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

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Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

He turns

Waste into Profit

with BREAXIT

A BREAXIT engineer — available at your request — makes on-the-lease tests of your emulsified oil and recommends the type and amount of BREAXIT to turn emulsions into pipe-line oil.

This on-the-spot test is an extra Humble service at no extra charge. Ask for a BREAXIT engineer to test your emulsion; get more oil at lower cost with BREAXIT.

● *For complete details on BREAXIT, write:*

Sales Technical Service Division
Humble Oil & Refining Co.
P. O. Box 2180 Houston, Texas

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HUMBLE OIL & REFINING CO.

tardy, absentee type." Gradually the distant-living employe notices this apparent untrusting attitude in the supervisor, and he develops a reciprocal lack of confidence in the management. Eventually, he ends up in the exit interview complaining about transportation, the ability of the supervisor, and lack of confidence in management.

Three other climates or patterns appear. A general *human relations pattern* emphasizes concern with broken promises by supervision, friction with co-workers, company interest in employe welfare, freedom of communication, promotion, ability of supervisor, confidence in management, and job effect on personal happiness. A *security pattern* emphasizes complaints about job security, working conditions, confidence in management, ability of supervisor, interest in employe welfare, broken promises by supervisor, job effect on personal happiness, and friction with co-workers.

An *upgrade pattern* is evident in the illustration in a tendency toward simultaneous complaint about promotion, pay, and freedom of communication. Poor housing complaint is also included, relating oppositely with pay complaint but consistently with grievances about promotion and freedom of communication. The "rush to get ahead" pattern is apparent here. Promotion and access to "higher ups" are considered important—along with pay and satisfying family housing. They do not feel that the present employment permits them to meet their pay and prestige goals fast enough.

General Interpretation—Some personnel policies which appear to save money in the short run may actually lose even more money in the long run because of the high costs of labor turnover. The over-all research suggests the high value to stockholders of managements and supervisors who are filled with warm understanding of human needs—administrators and leaders who are themselves willing to undergo considerable frustration in their relations with subordinates, to turn the other cheek, to work hard at earning and retaining confidence and long service of all personnel.—**The End**

For more data on advertised products, use Readers' Service Cards, last page.

The most compact, reliable sampler ever built . . .

THE NEW Gilbarco

Small in size... light in weight

AUTOMATIC SAMPLER

Here's a new compact, completely automatic, magnetically powered and electronically controlled sampler designed to provide a continuous sample from process or pipe lines.

USERS GET ALL THESE IMPORTANT ADVANTAGES.

- ★ Proportional to time or flow
- ★ Settings for 20 to 300 cycles per minute for more accurate sampling
- ★ No packing glands, no leakage
- ★ No electric motor, no mechanical switches
- ★ Simple to install and service
- ★ LOW initial cost . . . LOW maintenance cost
- ★ Completely explosion-proof . . . no pressure relief valves required
- ★ No hold-up time from pipe line to sample receiver; because a portion of the stream is by-passed through the sampler

Before you buy any other sampling unit, write for full details on this New Automatic Sampler.

GILBERT & BARKER MFG. CO. • WEST SPRINGFIELD, MASS. • TORONTO, CANADA

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EVERYTHING

for your corrosion protection problems

AN-SPEC Magnesium Anodes

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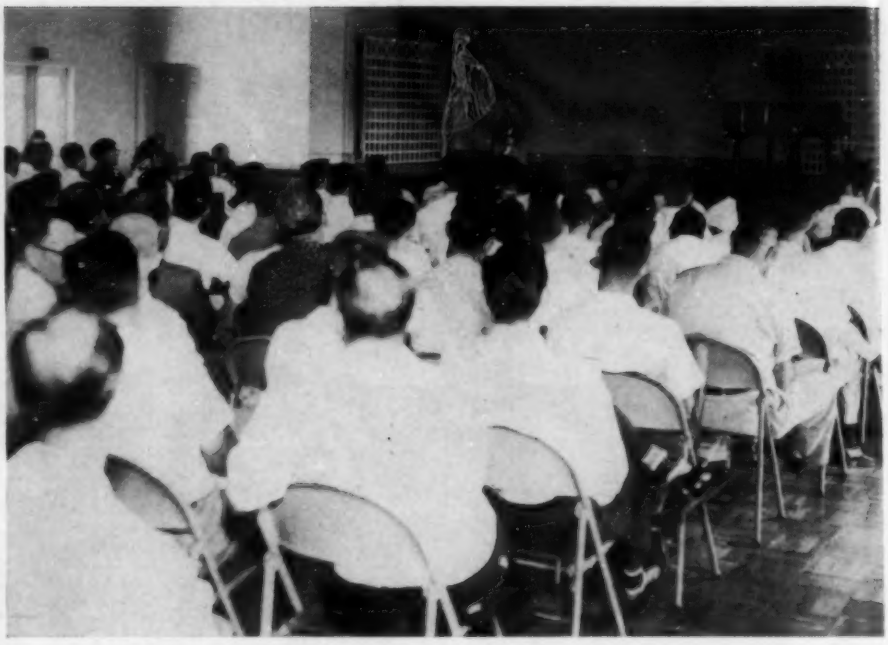
TULSA, OKLAHOMA



Paul Kayser, president of El Paso Natural Gas Company, addresses the general assembly of the 1954 Short Course in Gas Technology at Texas A. & I. in Kingsville.

It's School Days Again For Gas Industry Engineers

ENGINEERS FROM NATURAL GAS production and transmission companies return to college for a few days next month to brush up on latest industry developments. On June 1-2-3, about 250 of them will gather again at the Tenth Annual Short Course in Gas Technology on the campus of Texas College of Arts and Industries at Kingsville, Texas. The course given by the college in cooperation with industry is sponsored by the Southern Gas Association. Committee rosters read like an engineering Who's Who in the gas industry.

This year's course is under the supervision of an Advisory committee headed by Eli Cunningham of Texas Eastern Transmission Corporation. Committee members are: Al Bristow, Northern Natural Gas Company; Hudson D. Carmouche, Houston Pipe Line Company; James Clement, King Ranch; Julian L. Foster, Lone Star Gas Company; John F. Lynch, La Gloria Oil and Gas Company; W. C. McGee, Jr., Tennessee Gas Transmission Company; Clyde McGraw, Transcontinental Gas Pipe Line Corporation; C. L. Perkins, El Paso Natural Gas Company; James E. Pew, Sun Oil Company; L. C. Poindexter, United Gas Pipe Line Company; W. K. Sanders, Trunkline Gas Company; Roy A. Schuster, The Chicago Corporation, and Frank C. Smith, Houston Natural Gas Corporation.

An Administrative committee plans the course programs, arranges for speakers and is in complete charge of the presentation. Hugh F. Steen, El Paso Natural Gas Company, is chairman of the Transmission section and is assisted by Oliver W. Clark, Southern Natural Gas Company, and Paul L. Hughen, Texas Eastern Transmission Corporation. R. C. Granberry, Jr., Humble Oil & Refining Company, is chairman of the Production and Conditioning section. E. A. Rassinier, Trunkline Gas Company, and Homer Givens, La Gloria Oil and Gas Company, also serve in this section. R. R. Suttle, managing director of the Southern Gas Association and Frank H. Dotterweich, director of the short course, are also members.

Production and Conditioning section. This section will cover nine general topics including: The Influence of Lease Processing on Estimates of Gas-Condensate Recovery, F. O. Reudelhuber of Core Laboratories; Hydraulic Fracturing Increases Gas Well

CAN YOUR BUILDINGS PASS THIS FIRE TEST?

AFTER THE FIRE... A NEW PAINT JOB, AND READY FOR BUSINESS AGAIN.

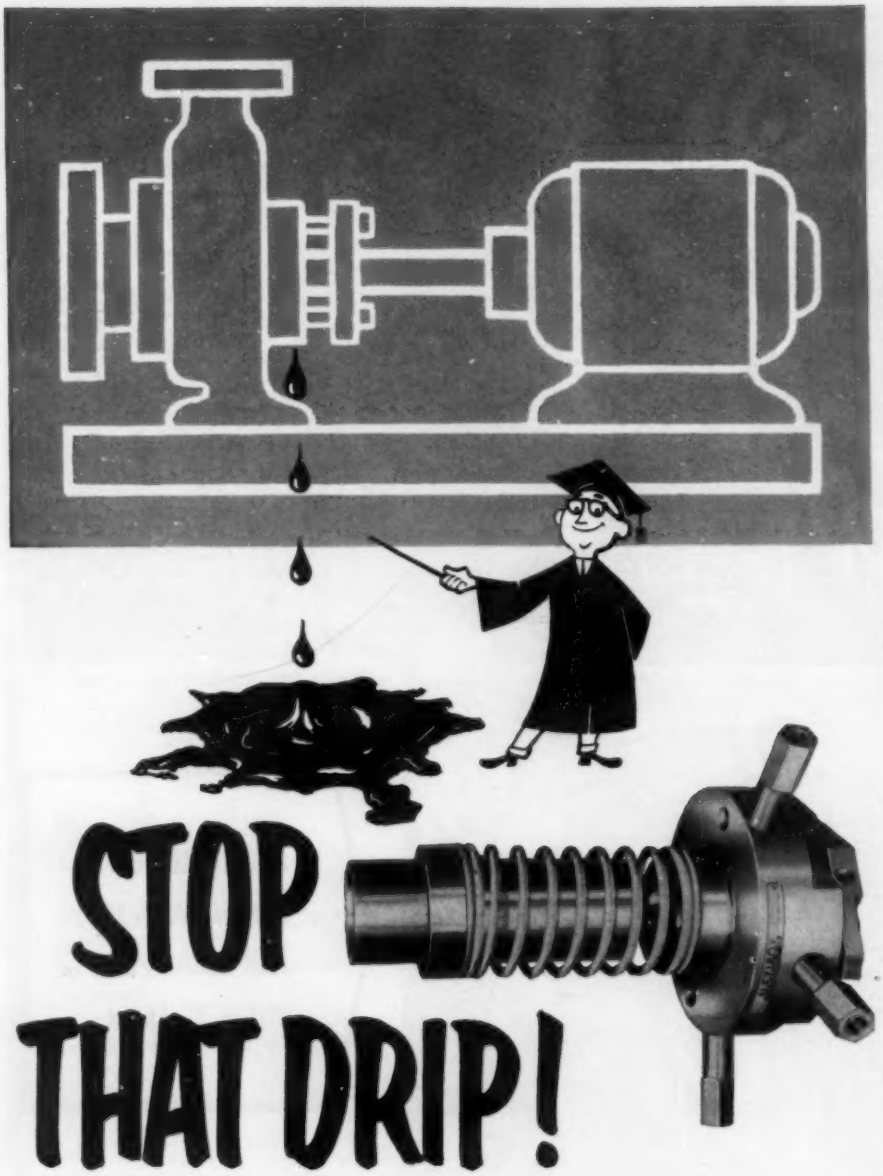
Here's a typical example of how Armco Steel Buildings reduce the threat of fire damage. A rubber tire-fed fire raged inside this 24-foot-wide building for a half-hour, destroying much of the contents. Yet the owner was able to put the structure back in service without replacing any building parts. New window glass and paint did the job.

Fire-resistance is just one advantage you can have in an Armco Building. Interlocking STEELOX Panel construction saves erection time and money; provides a sturdy, weather-tight building. You save framing, rafters, sheathing and roofing because the panels provide both structural support and finished exterior. Workmen need no special training to do a fast, efficient erection job.

The wide range of standard sizes makes it easy to meet your specific space needs. Floor areas are practically unlimited—from 20 square feet up! Whether your building problems include office, warehouse, meter station, pump house or other facilities, Armco Steel Buildings may be your most economical, permanent solution. Write for details. Armco Drainage & Metal Products, Inc., 5315 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

ARMCO STEEL BUILDINGS

ARMCO®



Pump stuffing box drip is a thing of the past when you install Sealol-Flexibox Mechanical Shaft Seals. In hundreds of leading refineries throughout the world, you'll find cleaner, safer, more efficient process pumps operating without leakage, thanks to Sealol-Flexibox Seals.

Take this big step towards greater safety, economy, and reduced maintenance. Write today for data and recommendations on mechanical shaft seals for your process pumps . . . or send for Bulletin 9 giving complete details.

Sealol Corporation,
175 Post Road, Providence 5, R. I.

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THE BALANCED PRESSURE SEAL

Deliverability, J. F. Bozeman, Dowell Incorporated; Problems and Economics of Dual Gas Well Completions, F. G. Prutzman, Sun Oil Company; Measurements of Full Well Stream Gas, Gale Cable and Joseph Eskew of La Gloria Oil and Gas Company; Permanent-Type Well Completions (truck exhibit), Gilbert H. Tausch, Humble Oil & Refining Company; Safety in Gas, Garland Neal, Texas Employers' Insurance Association; Data Reduction in Operation, Paul Condit, Paul Condit Company; Field Applications of Vapor Phase Cooling of Gas Engines, Brock Mott, Mott Company, and Trends and Regulation of Gas Production in Texas.

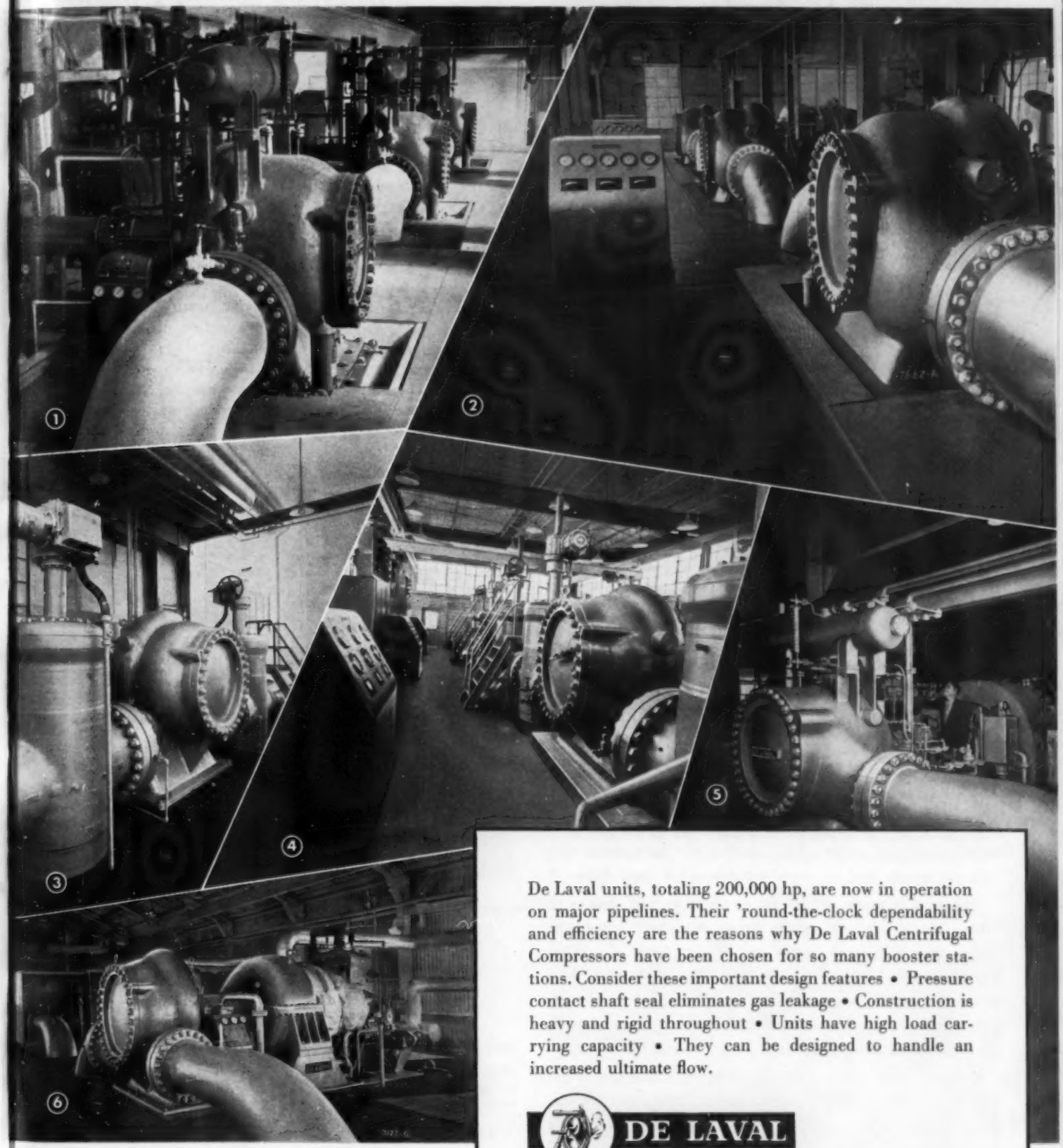
An open forum discussion on Methods and Equipment Employed in Gas Dehydration will have E. A. Rassinier as its moderator. Discussion leaders include Woodrow Mize, El Paso Natural Gas Company; J. L. Maher, National Tank Company, and C. K. Gravis, Atlantic Refining Company.

New techniques described in transmission section. A program covering eight general topics will be presented in this section. Topics are: Control Fire Method of Pipe Line Repair, G. Chabre, Southern California Gas Company and Harry Gavin, Southern Counties Gas Company of California; Right-of-way Procedures Construction and Operation, Dan Williamson, Transcontinental Gas Pipe Line Corporation; Internal Cleaning of Pipe Lines in Operation, Paul Hughen, Texas Eastern Transmission Corporation; Operation of Underground Gas Storage Fields, Frank Boyd, Texas Eastern Transmission Corporation; The SIE Analog Computer for Measurement of Fluid Flow Through Orifices, Frank C. Smith, Jr., and D. P. Gregg, Southwestern Industrial Electronics Company; Round Edge Orifices in Fluid Measurements, H. V. Beck, American Meter Company, Inc.; Liquids in Pipe Lines, Tom Mandry, El Paso Natural Gas Company; and New Developments of Pipe Line Coating, Charles L. Woody, United Gas Corporation.

Oliver Clark will act as moderator for a panel discussion on Methods of Testing Pipe Lines. Discussion leaders include S. Orlofsky, Gulf Interstate Gas Company; Gene Proper, Transcontinental Gas Pipe Line Corporation and L. C. Poindexter.—**The End**

For more data on advertised products, use Readers' Service Cards, last page.

These pipelines depend on DE LAVAL *Centrifugal Compressors*



Located in booster stations of:

1. *Northern Natural Gas Company*
2. *El Paso Natural Gas Company*
3. *Southern Counties and Southern California Gas Companies*
4. *Texas Eastern Transmission Corporation*
5. *United Gas Pipe Line Company*
6. *Transcontinental Gas Pipe Line Corporation*

De Laval units, totaling 200,000 hp, are now in operation on major pipelines. Their 'round-the-clock dependability and efficiency are the reasons why De Laval Centrifugal Compressors have been chosen for so many booster stations. Consider these important design features • Pressure contact shaft seal eliminates gas leakage • Construction is heavy and rigid throughout • Units have high load carrying capacity • They can be designed to handle an increased ultimate flow.

DE LAVAL

Centrifugal Compressors

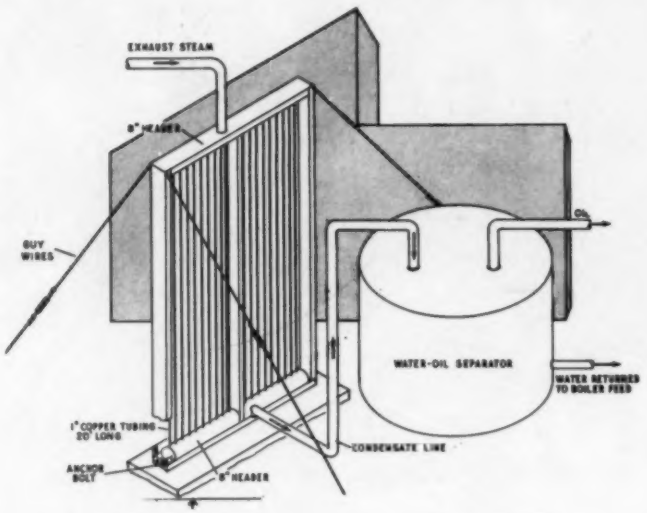
DE LAVAL STEAM TURBINE COMPANY

884 Nottingham Way, Trenton 2, New Jersey

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Air Cooled Condenser Saves on Boiler Make-Up

A simple atmospheric condenser is a proven money saver in areas where water shortages increase the cost of boiler make-up water. This shop-made unit condenses exhaust steam and recovers condensate at low cost.

The unit is made up of one or more vertical banks of tubes and a vessel to serve as an oil-water separator. Tubes, one inch in diameter and 20 feet long, are rolled into eight-inch headers at each end. The tube bank is then mounted into a structural frame as shown. Any vessel with sufficient hold-up time to give satisfactory separation of oil from condensate is an adequate separator.

Exhaust steam enters the top header, flows down the tubes where it is condensed by the cooling action of the wind. Condensate collected in the bottom header flows to the separator. There oil rises to the top and is removed. Water is pumped from the bottom to feed water storage.

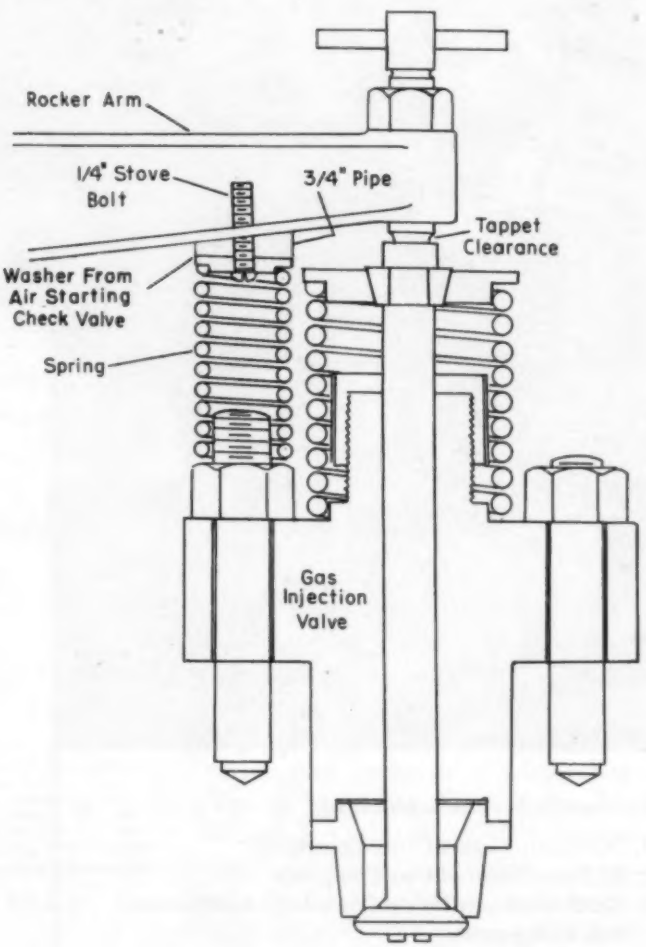
Condensate recovery has an added advantage where plants or stations use water high in mineral content. Recovery units cut down on the amount of deposits in the boilers of plants without water-treating facilities.

Stop Rocker Arm Flutter On Old Model Engines

Rocker arm flutter in older model two-cycle gas engines may often cause injection valve trouble and wear at push rod ends. An extra spring installed on the rocker arm will quickly eliminate this trouble.

Drill and tap the bottom of the rocker arm for a ¼-inch stove bolt directly above an injection valve stud. Cut a piece of ¾-inch pipe at an angle and about ⅜-inch long on the short side. A washer from an air starting check valve holds the pipe spacer in place when fastened with the stove bolt as shown.

Slip an air starting check valve spring into position over the extended injection valve stud and onto the seat under the washer. The spring can be removed by hand as it is free at either end. Slight compression on the spring maintains tappet clearance at valve end and keeps the push rod end tight.



Truck Mounted Pile Driver Speeds Fence Repairing

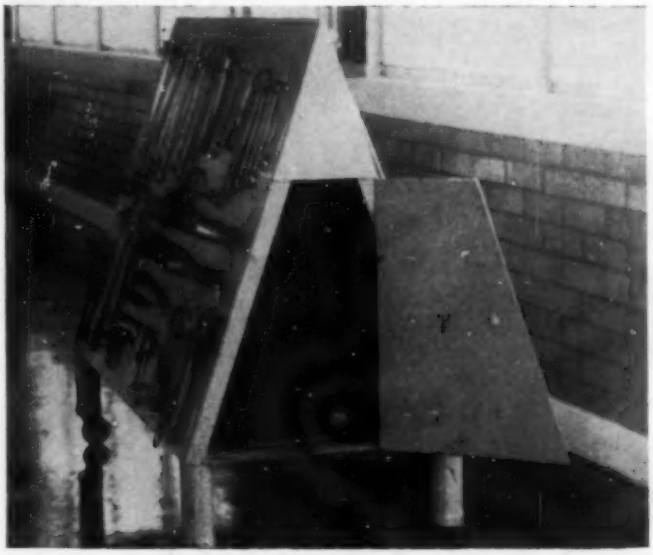
Save time and money in repairing fences along the right-of-way by driving posts with this "pile driver" mounted on an ordinary winch truck. The unit can be made from scrap steel.

First, bolt H-beams across the bed of the truck and, inside them, run channel iron slides to the upright driving column. Make a clamp of a salvaged valve wheel to secure the horizontal beams in position for driving operations.

The vertical column consists of two I-beams joined by a welded cross member at the top. This cross member carries the pulley for lifting the driving weight as shown.

To drive a post, place it in the driving cap which rides down inside the vertical members. When the post is in position, take a slight strain on the line which is on the winch cat-head. The driving weight is lifted and the line is slacked off quickly allowing the weight to fall and drive the post. This operation is repeated until the post is at the desired depth.

The "pile driver" may be quickly secured close in to the truck bed and moved to a new location.



Portable Cabinet Saves Steps For Station Maintenance Men

An easy-to-make tool cart is playing an important part in the maintenance of a gas compressor station. It is a portable cart that carries all tools necessary for routine maintenance of the large compressors and engine in the building.

The two sides of the rack, which are made of light-gage metal six feet long and four feet wide, are mounted on a triangular frame of angle iron. One of the sides provides a rack for small tools; the other side for heavy wrenches.

The interior of the portable tool cabinet serves as storage space for such items as lubricants and spare parts. The bottom of the rack is rectangular in shape and has legs of two-inch pipe. Heavy duty casters enable maintenance men to move the cart easily.

Movable Shacks Save Money On Many Construction Jobs

Station construction forces can make good use of unitized shacks such as these shown here. The small sheds, constructed of lumber and corrugated steel sheet, serve as offices for superintendents, engineers, and as communications centers and tool shacks. They are also useful as shops for welding, electrical and construction crews.

When the job moves, shacks are sucked-up on floats and moved two at a time. Tools and equipment are handy and secure when relocated. Moving time and setting-up time are saved and the cost of building larger shops is reduced.

Handtool Silhouettes Save Time

Painting black silhouettes on a handtool board in a pipe line warehouse will help keep track of tools. The visual aid shows exactly where each tool belongs, also when a tool is missing from the board.

As an additional benefit, the board speeds up inventory counts.

INSTALL
peak performance
INTO YOUR
compressors
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Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

Check THESE VOSS VALVE ADVANTAGES:

- Quiet, vibration-free operation
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- less power consumption
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- lower operating costs
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Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

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VOSS VALVES / J. H. H. VOSS Co., Inc. 785 East 144th Street, New York 54, N. Y.

Make Temporary Pipe Rack From Welded Scrap Pipe

When necessary to rack up pipe for a few months prior to use, low cost temporary racks may be welded from scrap pipe.

Two cross members for the foot of the supporting legs are notched and welded together at 60 degree opposite angles. A length of pipe is notched at each end and welded in a vertical position to the intersection of the footing cross. A short length of pipe with inside diameter large enough to fit the size pipe racked is split and welded to the vertical member to form a saddle.

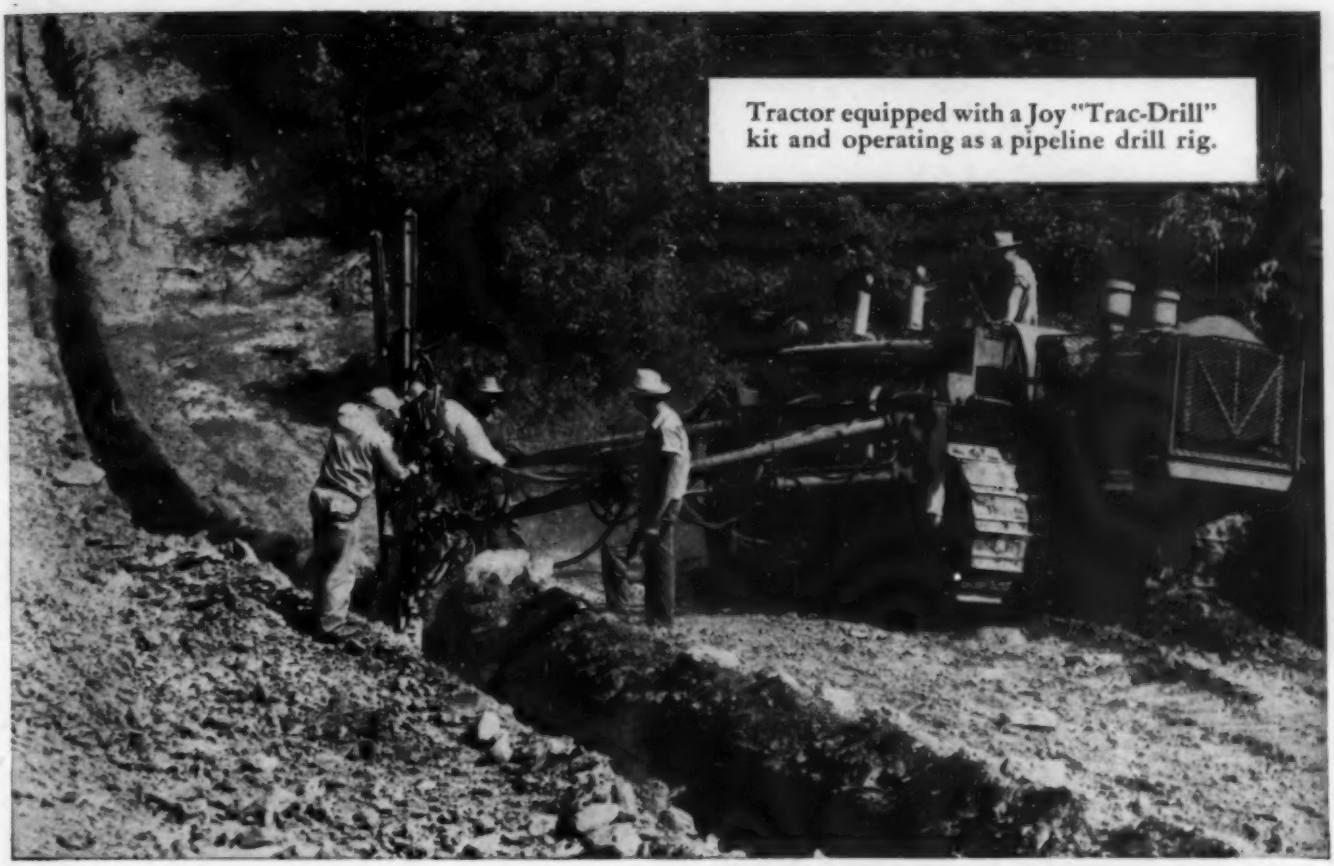
Several supporting legs are aligned and a length of pipe placed across the saddles to form a horizontal supporting joist. Two or three such joists are set up parallel to each other about eight feet apart to complete the rack.

Use Power Auger Assembly To Dig Anode Holes Quickly

A shop-designed trailer and boom assembly for a power auger has been used to good advantage in drilling holes for cathodic protection anodes.

The framework is mounted on an L frame attached to a small trailer. In operation, the power auger motor unit is mounted between the two uprights of the frame, holding the auger rigid. The auger may be raised and lowered by riding along the inside of the frame. Guide bars prevent the auger from twisting loose from the frame when it is being removed from the hole.

For more data on advertised products, use Readers' Service Cards, last page.



Tractor equipped with a Joy "Trac-Drill" kit and operating as a pipeline drill rig.

THE JOY "TRAC-DRILL"

A PIPELINER RIG THAT GETS THERE FASTER TO SAVE YOU TIME AND MONEY

This PIPELINER, the Joy "Trac-Drill," is a packaged drill-and-compressor unit for pipeline drilling that is easily assembled on *your* tractor. The assembly kit consists of drill and compressor "packages" and instructions for assembly. Drill package includes Joy Silver Streak Drills, Hydro Drill Jibs, mounting bracket, hydraulic pump and other accessories. Compressor package includes a Joy WL-80 compressor, mounting bracket, air receivers, etc.

Two drills are mounted on dual, hydraulically-actuated Joy Hydro Drill Jibs. With these jibs, the drills are quickly and easily positioned and are held absolutely stationary during drilling. This is a real "Pipeliner" rig . . . the double drill arrangement permits the drilling of several holes from each tractor setup.

The Joy "Trac-Drill" moves and operates as one self-contained unit. It moves in on those tough spots in the spread faster because there is no need to tow a separate source of compressed air into the area.

Consult a Joy Engineer TODAY for details on how you may equip your tractor for pipeline drilling. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer

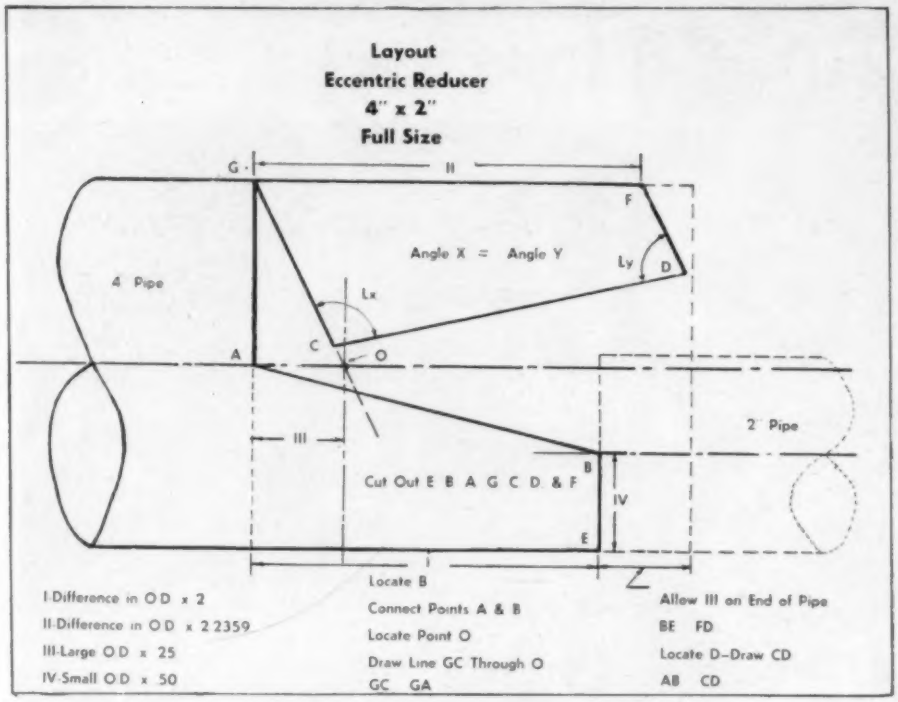
ABOUT Stationary and Portable Compressors . . . Rock Drills . . . Rock Bits . . . Electrical Connectors . . . Portable Lighting Lines.

WAD C-5363

JOY

CONSTRUCTION EQUIPMENT MANUFACTURERS FOR OVER HALF A CENTURY

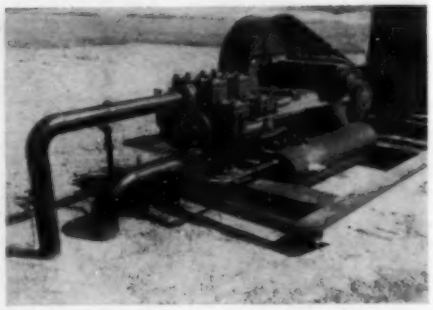
For more data on advertised products, use Readers' Service Cards, last page.



Lay Out Simple Eccentric Reducer

Here is a simple way to lay out an eccentric reducer. The directions are shown and this method will work for any size pipe within reasonable limits.

Be sure to allow the proper amount on the large pipe as shown in the sketch. The first step is to locate the various points and draw in the cut lines. Cut out E,B,A,G,C,D,P, and the remaining portion of the pipe that was allowed in step three. Then heat the pipe with a welding torch and hammer into shape. Then weld the two pieces together.



Sump Tanks Mounted In Skid Base of Field Pumps

Where field pumps are frequently moved, the fabrication of a sump tank in the pump skid base is a real time-saver. The tank remains intact during pump shifts, and all connections are moved with the unit. All that is required to move the pump is to disconnect the suction and discharge lines and the fuel line.

The tank, fabricated from eight-inch pipe, rests between the members of the skid base as shown. Copper tubing bleeder lines from the valve chambers on either side of the pump are conveniently connected. A ¾-inch line drains the piston rod chamber by gravity.

A ¾-inch line from the sump tank to the suction side of the pump permits draining when the sump is nearly full. By simply opening a gate valve the sump is emptied quickly.

Reinforcing Steel 'Chairs' Molded in Wooden Form

A simple wooden form can quickly provide enough reinforcing steel "chairs" for almost any size station slab job. The mold shown has 100 cavities provided by tapered separators.

Concrete grout is poured into the molds and struck off. The wire loop for holding reinforcing rods is then forced down into the wet concrete in each mold. After the concrete has set, any number of chairs may be removed as needed.

KEEP PURE DRINKING WATER ALWAYS HANDY

insist on the highest quality

Gotkool
water cans and coolers

Specify **"GOTKOOL"** the next time you order water cans or coolers. **"GOTKOOL'S"** exclusive construction keeps water cooler . . . fresher . . . purer. Extra wide, snug-fitting, splash-proof top keeps out impurities. Non-leaking, push-button faucets, either extended or recessed flush mounted. *Buy* **"GOTKOOL"** *at your supply store today.*

GOTKOOL Water Cooler — made in 2, 3, 5, 8, 10, 15, and 20-gallon sizes with extended or recessed flush-mounted faucet optional. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

GOTKOOL Water Can — made in 1½, 2, 3, 5, 10, and 20-gallon sizes without faucets. Extended or recessed flush-mounted faucets available at slight additional cost. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

Insist on the genuine — look for the Blue and Black Label with the name "GOTKOOL" in Red.

H. P. GOTT MFG. COMPANY
WINFIELD, KANSAS

Look at these exclusive design features of Cooling Sections, Structure and Drive!

G-R fin-fan
Air-Cooled
Heat Exchanger

1. G-R air-cooled exchanger design, construction and performance ratings are factual and guaranteed.

2. Performance records obtained from many millions of square feet of K-Fin cooling section elements.

3. Advanced designs of transfer surface, structure and drive mechanism.

4. K-Fin elements can be of the metal or alloy best suited to the particular fluids being handled.

5. K-Fin structure is strong and rugged—the same as used in over 15,000 G-R Bentube Sections.

Make sure you get *all* the advantages available in the G-R **fin-fan** Air-Cooled Exchanger. Investigate *now.*

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

GR-342

OVER

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YEARS

of heat transfer experience built into every

G-R fin-fan

G-R HEAT TRANSFER APPARATUS **fin-fan Air-Cooled Heat Exchanger**

For more data on advertised products, use Readers' Service Cards, last page.

Northern Pacific Enters Industry

Northern Pacific Railway Company will enter the crude oil pipe line transportation business following completion of negotiations in which the company acquired a 10 percent interest in the newly-organized $19 million Butte Pipe Line Company.

Shell Oil, the Murphy Corporation and Placid Oil are associates in the 450-mile Montana-Wyoming line. A 35-mile gathering line already in operation from the Pine and Cabin Creek oil fields will become a section of the Butte Pipe Line. Construction of the new line is scheduled for completion early this fall.

Northern Pacific is the second railroad to enter the pipe line industry in the past two months. Southern Pacific recently organized Southern Pacific Pipe Lines to construct and operate a products line from El Paso to Los Angeles.

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one for all Service

SUPPLYING ALL PIPELINE MATERIALS...PLUS COMPLETE ENGINEERING SERVICE

If you are required to furnish high quality materials and equipment for pipeline construction or maintenance, you can enjoy the following benefits of TOPAZ "one for all" SERVICE.

1. All materials and equipment furnished by one supplier, eliminating unnecessary time and paper work.
2. Fast, dependable service of a company large enough to supply all your needs, but small enough to give personal attention to each order.
3. Complete consulting, internal cleaning, testing and inspecting services.

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TGT Texas-Louisiana Line Gets Approval of FPC

Tennessee Gas Transmission Company of Houston has been given the go-ahead sign by the FPC to construct a new 30-inch line approximately 370 miles long from a point near Agua Dulce, Texas, along the Gulf Coast to the Kinder, La., area.

The line will be a substitute for approximately 211 miles of partial 30-inch main line loops and 21,240 horsepower in compressor capacity previously authorized by FPC but not yet constructed. Cost of the new line is estimated at $35,400,000, $12,400,000 more than the cost of the previously authorized line.

Canadian Firm Gets Permit To Build 106-Mile Line

Peace River Oil Pipe Line Company has been granted a permit by the Alberta Petroleum and Natural Gas Conservation Board to construct a new outlet for the Sturgeon Lake pool of northwestern Alberta, in western Canada. The 106-mile, 16-inch line will extend from Sturgeon Lake southward to Edison Station on the Trans-Mountain Pipe Line Company's trunk line for movement westward. The new line will have a capacity of 57,600 barrels daily.

Ownership is vested in Amerada Petroleum Corporation, Canadian Gulf Oil Corporation, Hudson's Bay Oil & Gas Company, Imperial Oil, Ltd., Shell Oil Company and Union Oil Company of California. Canadian Gulf Pipe Line Corporation will operate the line.

Construction is expected to begin after the spring breakup.

Construction to Start On Pacific Northwest Line

With the dismissal of a Trans-Northwest Gas Company suit which had blocked further action by Pacific Northwest following FPC approval of its San Juan Basin-Washington line, Pacific Northwest will get construction underway soon.

The suit in the Third Circuit Court of Appeals at Philadelphia was dismissed following agreement by all parties involved. Details of the agreement were not disclosed but reports are that Pacific Northwest agreed to buy certain assets of Trans-Northwest. Applications before FPC and SEC will be amended in a routine action.

Officials of Fish Engineering, builders of the line, report that construction will begin soon and more than 600 miles of line will be laid this year. More than 5000 men will be employed on the $163 million project. The 1460-mile line will deliver gas from the San Juan Basin to the Pacific Northwest region and link up with the Westcoast Transmission Company line at the Canadian border north of Seattle.

Current plans call for probable service to Colorado Interstate to serve the Denver area during the 1955-56 heating season and completion of the line by the Fall of 1956.

Tests Scheduled to Start On Military Line in Alaska

First oil for tests of the 620-mile military oil-products pipe line in Alaska is due May 25 at the southeastern Alaska port of Haines. A tanker will discharge 50,000 barrels of oil into storage tanks there for an extensive check of equipment at Station No. 1. Last section of the Haines-Fairbanks line was scheduled to be in place by May 1.

The $40 million pipe line, from tidewater to Alaska's interior, will provide diesel, jet and motor fuels for the far north's military bases.

Tests will continue through the summer, moving up the pipe line to other pumping stations at the Haines cut-off and Tok. The oil is expected to reach Ladd Air Force Base at Fairbanks about September 1. The line is due to be turned over by the contractors in the early fall.

The project is a joint venture of Williams Bros. of Tulsa; McLaughlin Construction Company and Marwell Construction Company.

Newport Steel LINE PIPE*

EXPERTLY MADE TO EXACT SPECIFICATION

Rigid control and inspection throughout every step of production make Newport a thoroughly reliable source for your line pipe requirements. From steelmaking furnace to rolling and final testing, technicians handle your order to ensure the exact quality and delivery you specify. Newport's entire pipe facilities are devoted to 4" and 6" sizes*—standard wall, or thin wall for maximum economy. Both meet API and ASTM specifications. Contact Newport for line pipe or any other products listed.

*SIZES AND WEIGHTS AVAILABLE

O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.134"	9.29
	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

NEWPORT PRODUCTS

Cold-Rolled Sheets
Hot-Rolled Steel in Coil
Hot-Rolled Pickled Steel in Coil
Hot-Rolled Sheets
Hot-Rolled Pickled Sheets
Galvanized Sheets
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ECONOMICAL WATERAIL-TRUCK DELIVERY

Newport Steel is ideally situated on the Mississippi-Ohio River system and the great Cincinnati rail-truck hub. New barge facilities, 7 major railroads, 143 motor carriers enable Newport to give economical, dependable delivery to the entire area of the Middle West and South.

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YOUR CONFIDENCE IS JUSTIFIED WHERE THIS FLAG FLIES

EMSCO TOWERS
stay on the beam
Bridle Guying Assures
Minimum Torsional Twist
For dependable microwave operations, the top of the tower must be held steady under all weather conditions. The unique bridle guying and superior structural features of Emsco microwave towers assure minimum torsional deflection . . . minimum maintenance costs.
A pair of guys on each side of Emsco towers are anchored in a reverse direction. If the tower tends to twist because of wind, three of the guys will tighten and hold deflection of the tower top within specifications. Conventional guys are used on the lower part of the tower.
Every Emsco tower design meets RETMA specifications. Hot Dip Galvanizing provides protection against corrosion. Bolted construction permits quick, sure visual inspection.
For guyed or self-supporting towers unequaled for safety, structural rigidity and economy . . . specify Emsco. Prompt delivery is assured.
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EMSCO MANUFACTURING COMPANY
Garland, Tex. LOS ANGELES, CALIF. Houston, Tex.
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Another typical Emsco microwave installation on Texas Eastern's natural gas pipeline system.

Underwater "Cluster" Line Being Laid in California

A 10,500-foot underwater pipe line system is being laid to connect Monterey Oil and Texas Company's offshore production island to a separation center on shore near Seal Beach, Calif. This system will consist of an 8-inch crude line and three 3-inch lines, all bound together in a bundle by $\frac{3}{16}$-inch steel straps. All lines will be mastic coated.

The 8-inch line will carry oil and gas from the offshore wells to the five-acre separation center ashore. The three other lines will be used for fuel, water and mud delivery to the drilling rig operating on the island.

A multiple conductor armored cable, also being laid, will provide electric circuits for telephones and controls.

A jet trencher is being used to provide a minimum of five feet of cover over the pipe "cluster." Because of the soft nature of the bottom, the ditch may often be as wide as 40 feet at the top to obtain proper cover. Pipe is being fabricated in 600-foot sections, which are coated and tested before being pulled into the ocean by a tug.

The system is being laid by Healy-Tibbitts Construction Company in association with Collins Construction, developers of the trenching technique used.

Southern Counties Plans Complete Looping of Line

If the FPC approves a recent application by Southern Counties Gas Company to construct 31.5 miles of 30-inch pipe line between Cactus City and Desert Center, Calif., it will result in complete looping of the company's 210-mile line from the Colorado River to Los Angeles. The $2.5 million project will boost the investment in the gas system to over $210 million. Construction will require about 60 days after approval.

San Diego Gas & Electric Plans Compressor Station

San Diego Gas & Electric Company is planning a $700,000 compressor station near Moreno, Calif., to boost the volume of gas it receives from the Texas-California pipe line there from 83 Mmcf a day to 112 Mmcf.

The station is expected to be in operation by December. It will include two 1100-horsepower gas engine-driven compressors.

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for fresh water, salt water and ground bed installations are available in the following standard sizes:

Type A*	**1" dia. x 60"**
Type B	**1" dia. x 60"**
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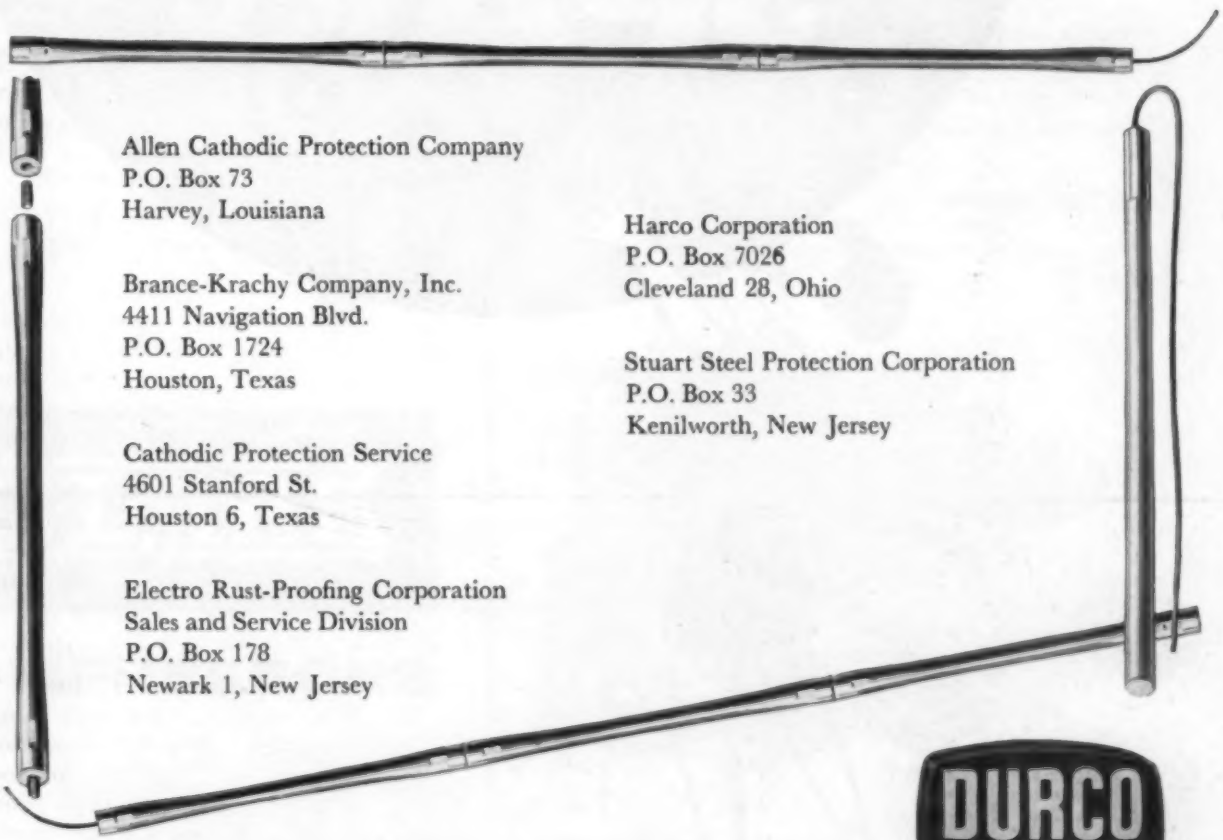
Type D	**2" dia. x 60"**
Type E	**3" dia. x 60"**

***Type A Duriron Anodes have cast integral monel inserts for joining end to end. All other types have a recessed protected lead connection with a 60" lead wire attached.**

Write or call one of the following Duriron Anode Distributors:



Allen Cathodic Protection Company
P.O. Box 73
Harvey, Louisiana

Brance-Krachy Company, Inc.
4411 Navigation Blvd.
P.O. Box 1724
Houston, Texas

Cathodic Protection Service
4601 Stanford St.
Houston 6, Texas

Electro Rust-Proofing Corporation
Sales and Service Division
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Newark 1, New Jersey

Harco Corporation
P.O. Box 7026
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CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, INC.
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For more data on advertised products, use Readers' Service Cards, last page.

AIR
TO
SPARE

...that's the secret of

CLARK TURBO-*SUPER*CHARGING

Obviously, any turbocharged 2-cycle engine must be supercharged. The extent to which it is supercharged is dependent on the volume of air and the pressure level maintained.

There's air to spare in Clark Turbocharged Compressors, even though a supercharging pressure of 6 psig is maintained at rated load and increased to 10 psig at maximum load.

Elevated pressures alone are not enough. While high pressure is desirable to increase power output, it must be accompanied by a sufficient volume of air: (1) To insure thorough scavenging with a cool, pure air charge for efficient combustion; (2) To thoroughly cool the power cylinder walls for proper lubrication of pistons, rings and cylinder walls.

Conversely, lower pressure supercharging reduces potential power output or results in "highly optimistic" ratings.

The only practical way to turbo-supercharge, therefore, is to provide a substantial volume of air at elevated pressures and to maintain the volume in proportion to the load placed on the engine. *That's precisely what Clark Turbo-Supercharging does!* The unusually high efficiency of the Clark Turbocharger permits pumping air at sufficient pressure and volume so that power output per cylinder can be increased from 33 to 65% over comparable non-turbocharged units, while cylinder wall temperatures are actually reduced.

Economical to install and operate, Clark Turbocharged Compressors are built in 8 sizes covering an 1100 to 3300 BHP range. Your nearest Clark representative has complete details. Write for Bulletin 134.

CLARK BROS. CO. • OLEAN, N. Y.
ONE OF THE DRESSER INDUSTRIES
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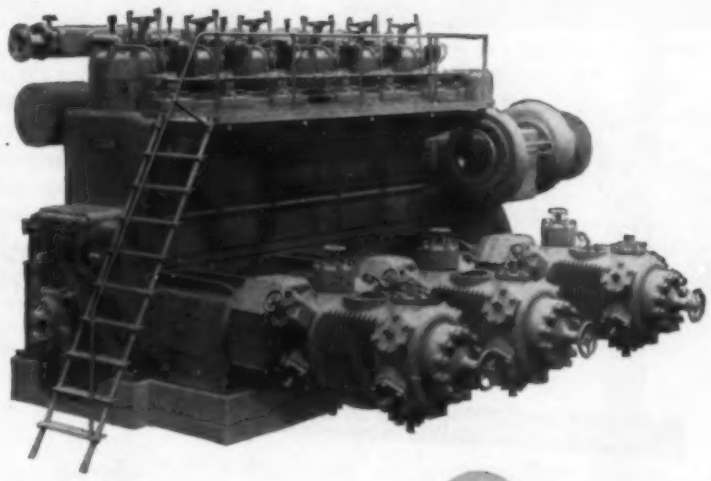

Clark sets the pace in compressor progress

75 YEARS

For more data on advertised products, use Readers' Service Cards, last page.

Lone Star Seeks Approval For Texas-Oklahoma Line

In an application before the FPC, Lone Star Gas Company has asked for authorization to construct a 230-mile pipe line from its existing line in Cotton County, Okla., to connections near Fritch, Texas. Purpose of the line is to deliver 100,000 Mcf per day to Natural Gas Pipeline Co. of America.

The proposed line would be made up of 170.3 miles of 22-inch and 60.2 miles of 26-inch pipe. An additional 440 horsepower would be required at the Katie compressor station and 50 horsepower in a Cruce field compressor station.

Lone Star has offered to sell Natural Gas Pipeline 200,000 Mcf per day under a 20-year contract. Estimated cost of the facilities in the proposal are about $19 million.

$16 Million Expansion Program For Texas Gas Is Approved

FPC has authorized immediate construction of $16 million in new facilities for Texas Gas Transmission Corporation.

Company officials said agreements have been reached with contractors and work is expected to get under way in the near future. Completion is scheduled for late fall 1955.

The project will bring the delivery capacity of the Texas Gas system to 1.1 billion cubic feet daily—an increase of 102 million. The new capacity will enable Texas Gas to increase firm daily deliveries to Ohio Fuel Gas Company, Columbia Gas System, in Ohio from 70 to 110 million cubic feet and to Louisville Gas and Electric Company from 60 to 75 million. Remainder of new capacity will be used to meet growing demands of the company's other customers throughout the Big River region.

Included in the program are approximately 90 miles of large diameter line, principally 26-inch, to loop existing facilities, a new compressor station at Columbia, La., and 11,500 horsepower at the company's existing stations. It also includes the construction of 100 miles of new pipe line in southern Indiana.

Oklahoma-Kansas Gas Lines Planned by Cities Service

Cities Service Gas Company has filed an application with FPC for permission to build a 93-mile, 26-inch pipe line from Blackwell, Okla., to near Independence, Kansas. Cost of the line is estimated at nearly $5 million.

The line would extend from the company's compressor plant in Blackwell to its present pipe line system near Independence.

The firm has also asked permission to construct a new compressor station and a 145-mile gathering system in Woods County, Okla., and Barber County, Kansas, to meet expected demands for natural gas. Cost would be nearly $3 million.

United Gas Seeks Permit For Line, New Station

United Gas Pipe Line Company of Shreveport, La., has applied to the FPC to construct approximately 63 miles of pipe line and a new 330-horsepower compressor station on its natural gas transmission system in Mississippi, Alabama and Florida.

Construction cost is estimated at $8,339,481. United also has requested authority to build facilities at the Jackson, Miss., gas field to test its efficiency and adaptability for storage purposes.

MOVE HEAVY LOADS EASIER WITH *SAFER* BRADEN WINCHES

The BRADEN PATENTED OIL-COOLED, FULLY ADJUSTABLE, AUTOMATIC SAFETY BRAKE makes BRADEN Winches safer, and easier to control on heavy handling jobs. This is important when handling extra heavy machinery or equipment that could be badly damaged while being moved.

BRADEN Winches are available in capacities to 100,000 pounds, and in models for all makes of trucks.

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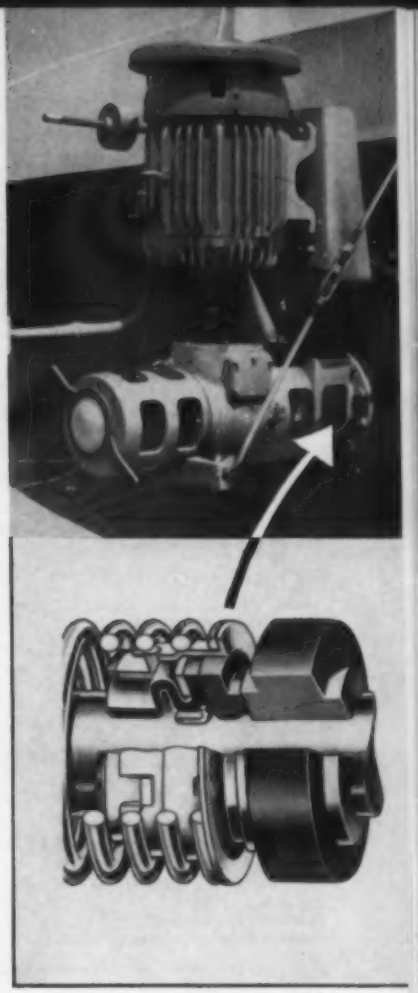
REMOVABLE SEAL CARTRIDGE is a complete unit assembly, easy to stock as a replacement, or quickly obtainable in all sizes and materials, for the simplest or most difficult operating conditions.



YOU CAN REPLACE A LIGHTNIN rotary seal in a few minutes—without special skill, without draining the tank or dismantling the mixer, without losing a pint of product. Seal is shown here without housing, to illustrate components.

Newest cost-saver in side entering mixers:

End stuffing box repacking . . . forever

with a rotary seal that's easy to replace

Now you can enjoy the solid maintenance savings of leakproof rotary sealing in a side entering mixer—without the headaches seal replacement *used* to cause.

For here, at last, is a rotary seal that runs *years* without adjustment—yet can be replaced *in a few minutes* when necessary, without draining the tank or dismantling the mixer, and *without need for special skills.*

Here's what you gain when you specify LIGHTNIN Mixers with new LIGHTNIN Seals:

1. You end leakage—for good. The seal positively will not leak during its operating life.
2. You *eliminate* the cost of repacking stuffing boxes. The LIGHTNIN Seal takes the place of a stuffing box. Under most conditions, it runs smoothly for *years* without changing.
3. You stop costly "nursing" of stuffing boxes. The seal *never* needs adjustment.
4. And most important (because it's never been possible before)—you can replace a LIGHTNIN Seal *in a few minutes,* should it ever become necessary. Only one simple *cartridge* component to remove and replace—and you're back in operation. So simple, anyone who can handle a wrench can do the replacement job *in minutes.*

Already, many oil companies are using LIGHTNIN Seals. Users report savings running into many thousands of dollars per year. Your LIGHTNIN Mixer representative can give you the full story—show you how much *you* can save. Call him today. Or get the facts by mail: Send the coupon for 8-page, fully illustrated bulletin.

Get the cost-cutting facts now... New 8-page Bulletin B-111 shows how you get maintenance-free sealing that really slashes fluid mixing cost to a new low. Send also for LIGHTNIN Mixer catalogs listed here. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

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FPC Approves Conversion Of Part of Little Inch Line

The FPC has authorized Texas Eastern Transmission Corporation to retire part of its Little Inch pipe line system from natural gas service and to construct new facilities to enable it to continue to provide service as it is presently rendered.

Texas Eastern plans to retire about 1168 miles of pipe line between Baytown, Texas, and Moundsville, W. Va. This section includes five compressor stations. The company also would retire part of the installed compressor horsepower at 16 other stations. Texas Eastern would then convert the Little Inch line to transportation of petroleum products.

The natural gas now being moved through the Little Inch system would be transported by means of the new facilities. These new facilities include some 481½ miles of pipe line, 86,900 horsepower in new compressor stations, and 36,020 additional horsepower in existing stations. Texas Eastern will require $71 million of new financing to carry out the program.

Pipe Line Contracts Not Let

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Alabama-Tennessee Natural Gas Co.—Florence, Ala.	25	8, 12	Gas	Alabama	$808,450	3.7 miles authorized
Alberta Gas Trunkline Co., Ltd.	315	18-36	Gas	Alberta Fields—Trans-Canada Terminal on Alberta-Sask. boundary	$37 million	Planned
American Louisiana Pipe Line Co.—666 Penobscot Bldg., Detroit, Mich.	1,289	22, 30	Gas	North Tepetate, La.—Detroit, Mich.	$130 million	1,172 miles conditionally authorized
American Pipe Line Corp.—New York City (Swinerton & Walberg, Engineering)	1,425 plus 485 miles feeders & distribution lines	24, 26	Products	Beaumont, Texas area—Newark, N.J.	$170 million	Planned
Anadarko Basin Pipe Line Co.	525	24	Gas	Wise County, Texas—Texas Eastern near Memphis, Tenn.	.....	Planned
Arkansas-Louisiana Gas Co.	66	24	Gas	Arkansas, Louisiana and Texas	$9,245,166	Approved
Ar-Mex Pipe Line Co.	900	8, 12, 14	Crude	Guernsey, Wyo.—Phoenix, Ariz.	$31 million	Planned
Attock Oil Co.	60	....	Gas	Dhulian Field—Rawalpindi, West Pakistan	.....	Planned
Butte Pipe Line Company-(Shell-Murphy)	450	16	Crude	Williston Basin—Guernsey and Fort Laramie, Wyo.	$19 million	Proposed
California-Oregon Pipe Line System	103	6	Crude	Crescent City, Calif.—Medford, Ore.	$2 million	Planned
Carolina Natural Gas Corp.—701 Wilder Bldg., Charlotte, N.C.	185	2, 12	Gas	North and South Carolina	.....	Proposed
Central Hudson Gas & Electric Co.	48	12	Gas	Albany—Kingston, N.Y.	.....	Applied to FPC
Cities Service Gas Co.—1st National Bank Bldg., Oklahoma City, Okla.	33	20, 26	Gas	To replace lines in Kansas and Missouri	$1,860,000	Authorized
	13	....	Gas	Labette County, Kansas	$285,000	Authorized
	15.5	16	Gas	Carter County—Garvin County, Okla.	$541,050	Authorized
	11.5	2, 4, 8	Gas	Johnson and Cass Counties, Mo.	$140,000	Before FPC
City of Dalton, Ga.	39	8	Gas	To connect with Southern Natural Gas Co. line	$2,940,000	Proposed
Clinchfield Coal Corp.—Dante, Va.	16	12	Gas	Dickenson County, Va.—Osborne Gap, Ky.	$785,000	Before FPC
Coastal Transmission Corp.—Houston, Texas	500	30	Gas	McAllen, Texas—Louisiana connection, Houston, Texas Gas.	$110 million	Considered
Coast Counties Gas & Electric Co.—360 Pine St., San Francisco	40	3, 4, 8	Gas	Coast and Valley region, Calif.	.....	Planned
Colorado Interstate Gas Co.	365	22	Gas	Rock Springs, Wyo.—Denver, Colo.	$23,299,000	Authorized
	115	4, 6, 8	Gas	Denver—Julesburg Basin—Basin Cities	.....	Before FPC
Colorado Western Pipe Line Co.—Dallas	708	....	Gas	Southeastern Colorado fields—Denver, plus laterals	$30 million	Planned
	328	16, 18	Gas	LaPlata County—Pueblo, Colorado Springs and Denver	$21,600,000	Authorized
Compania del Oleoducto Buenaventura—Cali, Colombia, S.A.	90	....	Products	Buenaventura—Cali, Colombia, S.A.	$4 million	Planned
Consolidated Gathering Systems, Ltd.	198	....	Crude	Sturgeon Field—Edmonton.	.....	Planned
Consolidated Natural Gas Corp.—New York	112	....	Gas	In Ohio—Plus other smaller lines	$6 million	Planned
Dixie Pipe Line Co.	20	8	Gas	Gwinville Field, Miss.—Transcontinental Gas line	$425,000	Proposed
El Paso Natural Gas Co.—El Paso, Tex.	32.5	10	Gas	Reagan and Upton counties, Texas	$799,000	Authorized
	74	....	Gas	Texas, New Mexico and Arizona	$13,800,000	Authorized
	370	....	Gas	Mountain Home, Idaho—Reno, Nev.	$35 million	Proposed
Empresa Nacional del Petroleo	80	6	Products	Concon—Santiago, Chile	.....	Planned
Governments of Southern Rhodesia and Portuguese South Africa	200	....	Products	Beria, Portuguese Mosambique—Umtalia, Southern Rhodesia	.....	Considered
Hope Natural Gas Co.—445 W. Main St., Clarksburg, W. Va.	33	8, 10, 12	Gas	Wyoming County, W. Va.—Buchanan County, Va.	.....	Proposed
Houston Texas Gas & Oil Co.—4604 Main St., Houston	1042	18, 24, 36	Gas	Louisiana—Miami, Fla.	$110 million	Considered
Idaho Natural Gas Co.—Goodland, Kansas	....	....	Gas	Pacific Northwest line—points in Southern Idaho	.....	Proposed
International Pipe Line Co., Inc.—227 N. Colfax Ave., Minneapolis, Minn.	132	8	Products	Wrenshall, Minn.—Minneapolis Bulk Terminal	$4,250,000	Planned
Kansas-Nebraska Natural Gas Co.—Phillipsburg, Kansas	283	6-12	Gas	Central and northeast Nebraska	$4,096,890	Some contracts let
Kentucky-West Virginia Gas Co.	32	12	Gas	Service line to Maytown, Ky.	.....	Before FPC
Keystone Pipe Line Corp., Philadelphia	48	8	Products	Boot—Fullerton, Pa.	$1,875,000	Approved
Lateral Gas Pipe Line Co.—Cedar Rapids, Iowa	27	4	Gas	Grant—Clarinda, Iowa	$267,000	Proposed
Lone Star Gas Co.—Dallas	230	22, 26	Gas	Cotton County, Okla.—Fritch, Texas	$18.7 million	Before FPC
Malco Pipe Line, Inc.	91	6	Products	Prewitt, N.M.—Albuquerque	$1,250,000	Planned
Mayflower Pipe Line Co.-(Pine Tree Natural Gas Co.) —70 Pine St., New York, N.Y.	200	....	Products	New Jersey refining area—New England	.....	Planned
Michigan Consolidated Gas Co.—415 Clifford, Detroit	25.5	12	Gas	Sparta—Muskegon, Mich.	$13 million	Proposed
Michigan-Wisconsin Pipe Line Co.—500 Griswold, Detroit	252	4-24	Gas	Wisconsin	$11 million	Proposed
Missouri Central Gas Co.	25	6	Gas	Moberly—Macon, Mo.	.....	Proposed
Missouri Public Service Co.—Warrensburg, Mo.	136.4	8-10	Gas	New Franklin, Mo.—Grundy County, plus laterals	$5 million	Proposed
Montana-Dakota Utilities Co —Minneapolis	56	2, 4, 6	Gas	Hettinger and Stark counties, N.D.	$728,854	Authorized
Moore-Stoner Co.	200	6	Products	Glendive, Mont.—Minot, N.D.	$2,000,000	Planned
NATO	1920	4-10	Products	To serve military bases in Western Europe	.....	Foster-Wheeler Prime Contractors
Natural Gas Pipe Line Co. of America—20 N. Wacker Dr., Chicago	479	20, 26	Gas	Wise County, Texas—Fritch, Texas	$28.5 million	Before FPC
Natural Gas Producers, Inc.—Colorado Springs	61.8	12	Gas	Yenter Pool—Denver	$1,374,000	Planned
	49	10	Gas	Denver-Julesburg Basin—Fort Morgan, Brush and Denver	.....	Planned
Natural Gas Storage Co. of Illinois—Chicago	35	36	Gas	Delivery from Herscher, Ill. storage field.	$7 million	Before FPC
Nebraska Pipe Line Co.	220	6	Products	Cheyenne, Wyo.—North Platte, Neb.	$4 million	ODM certificate granted
New River Gas Co.	50	....	Gas	Summers-Monroe Counties, W. Va. and Narrows and Dublin, W. Va.	.....	Planned
New York State Natural Gas Corp.	21	20	Gas	Portageville—Craigs Connection Loop	.....	Before FPC
NNCW Pipe Line Co.—Dallas, Texas	127	8, 10	Crude	Clareton Field—Casper, Wyo.	$3.6 million	Planned
North Dakota Natural Gas Co.—St. Paul, Minn.	500	6, 10, 12	Gas	Tioga-Minot, Fessenden, Devils Lake and Fargo, N.D., plus 6" feeder lines	$10.8 million	Proposed
Northern Natural Gas Co.—2223 Dodge St., Omaha	167	24	Gas	Farmington, Minn. to Duluth, Minn. and Superior, Wis.	$12 million	Before FPC
	329	2, 12	Gas	Sioux Falls to Aberdeen, S.D.	$6,661,100	Proposed
	310	24	Gas	Tioga to Fargo, N.D.	$18,494,000	Planned
	....	....	Gas	To interconnect with Natural Gas Pipe Line	$244,000	Planned
	403	24, 30	Gas	Emerson, Manitoba, Canada—Farmington, Minn.	$32,813,000	Before FPC
Northwestern Utilities, Ltd.—10124-104th St., Edmonton, Alberta, Canada	42	12	Gas	Bonnie Glen—Edmonton, Alberta	$1.4 million	Proposed
Pacific Northwest Pipe Line Corp.—M&M Bldg., Houston	1466 plus 443	Various	Gas	San Juan Basin—Pacific Northwestern states	$163 million	Approved

Continued on Page 94

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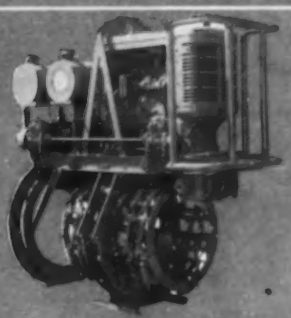

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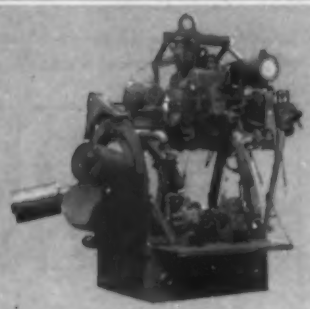

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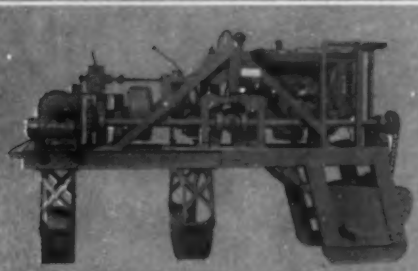

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Pipe Line Contracts Not Let—(Continued)

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Pawnee Pipe Line Co.	15	8	Crude	Northeast Colorado Sector—Denver-Julesburg, Basin	.....	Planned
Peace River Oil Pipe Line Co., Ltd.	106	12	Crude	Sturgeon Field—Edison, Alberta, Can.	.....	Authorized
Permian Basin Pipe Line Co.	11	6	Gas	Lea County, N.M.	.....	Before FPC
Petroargentina	370	16	Crude	Newguen—Bahia Blanca, Argentina	$40 million	Planned
Petroleos Mexicanos—Ave. Juarez, 94, Mexico City	440	20	Gas	Brazil—Tampico—Posa Rica, Mexico	.....	Planned
	260	6, 8	Products	Lagos, Mexico—Guadalajara, Aguascalientes and Salamanca	.....	Planned
	145	12	Crude	18 de Marso Field—Monterrey, Mexico	.....	Considered
	72	12	Crude	Posa Rica—Atzacapotsalco, Mexico	.....	Proposed
Phillips Petroleum Co.—Bartlesville	54	6	Products	Goldsmith—Borger, Texas	.....	Planned
Salt Lake Pipe Line Co.	....	....	Products	El Paso, Texas—Albuquerque, N.M.	$4 million	Planned
Santos Jundiai Railway Co.—Brazil	....	8, 14, 22	Crude & Products	Expansion of Santos—Sao Paulo system	$5 million	Planned
Shell Pipe Line Corp.	22	6	Crude	Ropes Field, Texas	.....	Proposed
	15	4	Crude	Brahaney Field, Texas	.....	Proposed
Shenandoah Gas Co.—Lynchburg, Va.	40	3, 4, 8	Gas	Virginia Gas Transmission Co. System—Virginia and West Virginia towns	$1,470,000	Authorized
Sioux Oil Co.	50	....	Products	Newcastle, Wyo.—Rapid City, N.D.	$1 million	Planned
Southern Counties Gas Co.	31.5	30	Gas	Cactus City—Desert City, Calif.	$2.5 million	Proposed
Southern Pacific Pipe Lines, Inc., San Francisco	....	8–16	Products	Los Angeles—El Paso	$30 million	Planned
Sturgeon Pipe Line, Ltd.	100	12	.....	Sturgeon Lake Field—Trans-Mountain system	$6,500,000	Planned
Sunflower Pipe Line Co.—Tulsa, Okla.	265	3–6	Products	Kearny, Grant and Haskel Counties, Kansas—Wichita, Kansas	$3.5 million	Authorized
Tennessee Gas Transmission Co.—Box 2511, Houston	370	30	Gas	Agua Dulce, Texas—Kinder, La.	$35.4 million	Authorized
Texas Eastern Transmission Corp.—Texas Eastern Bldg., Shreveport, La.	382	24	Gas	Beaumont, Texas—Kosciusko, Miss. plus 99 miles lesser diameter	$71.8 million	Proposed
Texas Gas Transmission Co.—416 W. 3rd St., Owensboro, Ky.	90	20, 26	Gas	Looping portion of Louisiana-Tennessee Line plus 110 miles Indiana lateral	$17.5 million	Authorized
Trans-Canada Pipe Line, Ltd.—Calgary, Alberta	2240	30, 36	Gas	Alberta—Eastern Canada	$297 million	Approved
Transcontinental Gas Pipe Line Corp.—3100 Travis St., Houston	....	....	Gas	Connecting facilities with Texas Eastern Penn-Jersey in Pennsylvania and New Jersey	$131,628	Authorized
Triangle Pipe Line Co.	500	12	Products	Arkansas City, Ark.—Covington, Ky.	$24.5 million	Proposed
Trunkline Gas Co.	24	....	Gas	Loop present line	$17.7 million	Before FPC
Union Oil Co. of Canada, Ltd.—Chatham, Ontario	180	24	Gas	Dawn Gas Field to Lamberton County to deliver gas to Dominion Gas Co.	.....	Planned
United Gas Pipe Line Co.	63	....	Gas	Various location in Miss., Ala. and Florida	$8.3 million	Before FPC
U. S. Navy	600	10	Products	Rota—Zaragoza, Spain	$40 million	Planned
	450	8	Gas	Gubik Field—Fairbanks, Alaska	$20 million	Planned
Utah Natural Gas Co.	40	16	Gas	Orem—Salt Lake City, Utah	.....	Planned
Virginia Natural Gas Co.	153	....	Gas	Buckingham—Richmond and Portsmouth, Va.	.....	Planned
West Coast Pipe Line Co.—Mercantile Bank Bldg., Dallas	960	24, 26	Crude	Wink, Texas—Norwalk, Calif.	$106 million	Planned
Westcoast Transmission Company, Ltd.	650	30	Gas	Peace River Fields-Sumas, Wash.	$140 million	Authorized
	....	30	Gas	Peace River Fields—Okanagan Valley	.....	Planned
	....	....	Gas	Alberta—Quebec	.....	Considered
Wilcox Trend Gathering System, Inc.	16	16	Gas	Loop near Provident, Texas	$2.2 million	Before FPC
Winnipeg and Central Gas Co.	450	4–8	Products	Tioga, N.D.—Winnipeg, Canada	$20 million	Planned
Wyoming Gas Products Corp.	....	....	Gas	Gathering system in Weston County, Wyo. to feed gasoline plant	.....	Planned
Yacimientos Petroliferos Fiscales Bolivianos	170	4	Crude	Bermejo—Tupinza, Bolivia	.....	Planned

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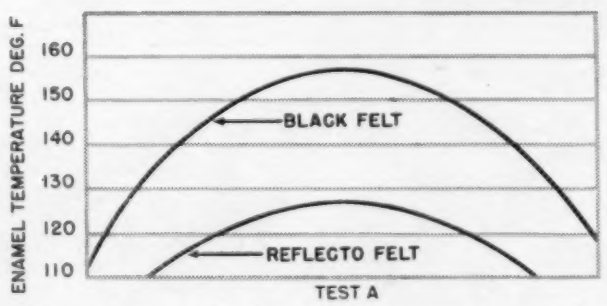

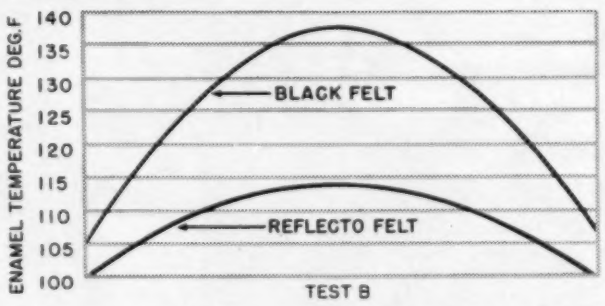

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PIPE LINE INDUSTRY'S VIEWS OF THE NEWS

- Three proposals hold attention in gas fight . . . • Independent unions may merge.
- Oklahoma's minimum gas price upset . . . • TIPRO to continue Economic Waste fight.

Gas Bills In Final Lap

Legislation to amend the Natural Gas Act is in the final lap of its journey through the Congressional maze.

Proponents and opponents of the effort to free producers from government control have had their say before the House Commerce Committee.

The committee will now construct one bill from 22 separate proposals with aims ranging from complete antagonism to absolute agreement with industry's demands that it be permitted to function unhampered under the principles of free enterprise.

Three proposals have received most attention:

1. The Harris-Hinshaw Bill, supported by the oil and gas industry.

2. The Heselton measures, backed in varying degree by consumer spokesmen. One Heselton proposal provides that production or gathering, which are exempt from regulation, must not include sale in interstate commerce for resale, thus holding with the Supreme Court decision in the Phillips case. The other bill would exempt from price regulation those independent producers whose sales in interstate commerce do not exceed 2 billion cubic feet a year.

3. The Staggers Bill, supported by coal, the railroads and labor. It would "conserve" gas by bringing interstate pipe line direct sales to industrial consumers under FPC control. Coal, fighting particularly hard for the Staggers Bill, directed its heaviest ammunition against loss of the boiler fuel market to natural gas. It insisted that this came about because pipe line companies have made "dump" prices to large consumers.

At month's end, it appeared likely that a measure similar to the Harris-Hinshaw Bill would finally be adopted, but a hard fight lay ahead on the escalator and most favored nation clauses.

TIPRO Plans Tax Study

A long-range study to determine how much taxes the industry should pay to the state of Texas was set in motion last month by the Texas Independent Producers and Royalty Owners Association.

"We may be paying too much or just the right amount," said TIPRO President Alwyn P. King, Jr., of Houston. "We want to find out by comparing our taxes with those of other major industries."

King said that, to his knowledge, this is the first such tax study undertaken in the industry.

Independents May Merge

It appeared last month that oil labor leader Jack Knight's pet "Philadelphia Plan" might be stymied by a "Baltimore Bargain."

The Philadelphia Plan aimed at the capture by the CIO of about 800,000 workers in 20 independent oil and chemical unions.

The "Baltimore Bargain" would bring into being one great union of the employes of the Jersey Standard group. Groundwork for the organization was laid last month by a merger agreement between committees of three unions—Independent Petroleum Union, Inc., of Baltimore, Standard Refinery Union of Bayonne, N. J., and Bayonne Marine Employes Union.

Ten other unions of the Jersey family have participated in the merger talks and will soon make a decision. If the agreement is ratified, an Esso International Union would come into being about September 1 at a convention likely to be held in Baltimore.

Minimum Gas Price Upset

The Supreme Court was up to its old tricks of confusing everybody in the gas industry last month.

Even as the Congress toiled to clarify the Natural Gas Act beyond the ability of the High Court to again misinterpret its original meaning, the nation's top judiciary was nullifying Oklahoma's minimum gas price law in phraseology that caused general bewilderment.

The Court ruled that the state of Oklahoma does not have the right to set a minimum price regulation on processed natural gas sold for immediate shipment outside the state.

By specifying processed gas, the Court invited speculation that it was, by inference, saying that states do have control until production and gathering have ended. This was the view taken in Kansas, which has set minimum wellhead prices without attempting to regulate processed gas.

In Oklahoma City, Ray C. Jones, vice chairman of the Corporation Commission, declared the ruling would have little effect in that state, where the current gas price in the Hugoton-Guymon area is 9.8262 cents.

The Court's 7-1 opinion was unusually brief. It merely said that such a regulation is exclusively the business of the FPC. Justice William O. Douglas, the lone dissenter, was of the opinion that until Congress enacts a law prohibiting a state from regulating minimum prices on interstate gas, Oklahoma has a right to fix prices.

The Oklahoma case originated from a challenge by the Natural Gas Pipe Line Company of America, which purchases gas from the Hugoton-Guymon field for distribution in central Illinois. The State Supreme Court ruled that the minimum price was set for conservation purposes and to eliminate waste, and, therefore, was an Oklahoma matter and within the state's power.

FPC Authority Challenged

Federal Power Commission authority to decide whether the Interstate Transmission Company's rates are set by "zoning" or "postage stamp" method was challenged by Sen. Edward Thye, R-Minn.

FPC Chairman Jerome Kuykendall, appearing before the Senate Appropriations Committee, explained that, under the zoning formula, rates paid by local distribution firms vary with the distance from the wells. Under the postage stamp technique, every customer on the line pays the same rate.

They declare: "I can see New England, for instance, paying a great deal more for the gas piped up from Kansas, Oklahoma or Texas than a state such as Kentucky." He also said that a city paying for gas under the zoning method is at a disadvantage for attracting or holding business. He named Omaha and St. Paul-Minneapolis as potential examples.

Kuykendall declared that most major pipe line companies operate under the zoning formula, with Northern Natural Gas Company the largest exception.

Kerr-McGee Gets Line

Deep Rock Oil Corporation transferred pipe line, refining and marketing facilities to Kerr-McGee Oil Industries, Inc. Kerr-McGee is paying Deep Rock $17 million of cumulative, 4.5 percent convertible, preferred stock, plus oil payment for undeveloped leases. Deep Rock is transferring to Kerr-McGee $5 million in cash and $12 million in assets. Also transferred is a 30-mile pipe line from Cushing refinery to Great Lakes Pipe Line and a few service stations.

Texas-Coast Line Favored

Hearings on a proposed crude line from West Texas to California will be held by the House Armed Services Committee.

Rep. Dewey Short (R-Mo.) has introduced a resolution demanding an inquiry into the line, projected by L. M. Glasco of Dallas.

"I've always thought a pipe line from West Texas to the Pacific Coast is necessary from a standpoint of national defense," declared Rep. Carl Vinson (D-Ga.), chairman of the Armed Services Committee. "I'm for it. I hope it can be built by private enterprise. If not, perhaps the government should build it."

TIPRO to Continue Fight

The Texas Independent Producers and Royalty Owners Association was losing a skirmish over its Economic Waste Bill last month.

But, said President Alwyn P. King, Jr., the battle has just begun.

The 5000-member TIPRO organization, of which more than one-third are producers, has been going it virtually alone in a struggle so noisy as to be heard all the way to Washington, where some said the Texas yells for more regulation at the state level was drowning out the industry's demands for less regulation at the national level.

With the Texas Legislature due to adjourn May 11, the Economic Waste Bill appeared to be headed nowhere, and King conceded that its chances may have been dimmed by industry's anxiety to make no move which could be interpreted as being at cross-purposes with the Harris Bill, which is being urged upon Congress to emancipate the independent producers from FPC control.

No such conflict as this will be present at the next legislative session, TIPRO is thinking, and in the meantime there will be an educational campaign to remove another major objection to the measure. This is the notion that the Economic Waste Bill is a price-fixing measure because it will permit the Texas Railroad Commission, upon application of any interested party, to determine the value of gas produced from any well or field in the state.

Not so, said King: "It simply empowers the Texas Railroad Commission to shut in gas fields when it can be established upon individual hearing that the price of raw gas at the wellhead is so low as to constitute economic or physical waste.

"We support an Economic Waste Bill which simply authorizes the appropriate state conservation body to prevent waste by compelling renegotiation wherever waste is found to exist."

Line Building Estimated

Products lines totaling 6719 miles and crude lines totaling 4713 miles are scheduled for completion in 1955-56, according to the Committee for Pipe Line Companies. The products lines will cost an estimated $328 million and the crude lines, $262 million. In addition, another 2452 miles of line will be converted to products.

Products line completions totaled 2862 miles in 1954, not counting 550 miles converted to products, at a cost of $106 million, it was reported. Crude line completions were put at 2478 miles at an estimated cost of more than $130 million.

The committee also reported that pipe line movements of principal products more than doubled from 1944-54, Gasoline, kerosine and distillate movements rose from an average of 724,000 barrels per day in 1944 to an average of 1,795,000 barrels in 1954.

Gas Lines' Revenues Up

Operating revenues of gas pipe line companies increased 13.2 percent for the 12-month period ending in January, the Federal Power Commission reported.

Revenues were $1,621,819,045 compared with $1,432,765,516 a year earlier.

Receipts in January were $180,380,165, up 13.6 percent over the year-ago total of $158,715,991.

Operating expenses of the companies during the month of January totaled $114,405,691, up 17 percent over January of last year.

Shale Oil Cost Shrinks

Improved techniques in the last four years may have dropped the cost of producing crude from shale by 25 percent, the Interior Department declared in its annual report on synthetic liquid fuels. Dollar-wise, that would mean a production cost of $2 per barrel.

"Since 1951," Interior reported, "developments in mining techniques and the experimental scale development of the gas combustion retorting process have advanced, and if preliminary Bureau of Mines estimates of the cost of mining and retorting were substituted in the NPC study (made in 1951), the cost of crude oil production would be reduced about 25 percent."

The report declared that the maximum size a northwestern Colorado oil industry might reach would be between 1 million and 2 million barrels of crude shale oil a day. One limiting factor would be the availability of water.

World Oil Yield Rising

Rising world crude production is reflected by the latest report made by the Bureau of Mines. Daily average output for October of 13,678,000 barrels amounted to a 1.8 percent increase from September.

The report, prepared by J. V. Hightower, commodity-industry analyst, under the supervision of H. J. Barton, Branch of Petroleum Economics, Division of Production, showed a record production during October for the Middle East producing areas. Total daily average yield for the area was 2,938,000 barrels. That new high was built on daily average production records in Iraq, 683,000 barrels, and Kuwait, 1,070,000 barrels. Saudi Arabian production was reported up 2.0 percent, to 961,000 barrels a day.

A major rise—3.2 percent—was reported in Venezuela's production during October of 1,912,000 barrels daily.

Other highlights of the October oil operations report:

- Crude imports into Western Europe averaged a record 1,981,000 barrels a day, up 14.7 percent. Italian imports reached a record of 435,000 barrels daily, up 56.5 percent. Crude shipments to the Netherlands averaged 201,000 barrels a day, an 81 percent rise. French, German and United Kingdom imports remained about the same.
- Crude exports from the Middle East, exclusive of shipments to Bahrain Island and Aden, averaged a record 2,286,000 barrels a day—an increase of 6.1 percent. Movements from Kuwait also chalked up a record in reaching 1,019,000 barrels, up 10.7 percent. Saudi Arabia exported an average of 773,000 barrels a day, up 69,000 barrels daily from the previous month.
- Total world crude runs to stills, exclusive of Russia and Eastern Europe, averaged 12,187,000 barrels a day, up 2.0 percent. This gain, said the report, reflected material rises in daily average runs in Venezuela, United Kingdom and the Netherlands. During October, Standard-Vacuum Oil Company's new refinery in India operated at capacity.
- World crude stocks, according to available data, rose 78,000 barrels daily, compared to the September decline of 283,000 barrels daily.

Will Ike Use Imports Whip?

The President apparently assumed responsibility for maintaining imports at a reasonable level last month in a Congressional horse-trade that cleared his liberalized foreign trade program through the Senate Finance Committee.

Under a compromise reportedly made with White House sanction, the Senate group voted by 13-2 to adopt the Ike-liked trade program, but with the stipulation that he be given authority to curb imports, either by quotas or increased tariffs, when the products involved have the effect of jeopardizing national security.

Sen. Walter George, Georgia Democrat who was a leading advocate of the compromise amendment, said the proposal would put a whip in the President's hands and promised that he would use it.

As approved by the committee, the bill would extend the reciprocal trade agreements act for three years from June 12 and give the President authority to reduce tariffs 15 percent during that period in return for similar advantages in foreign markets. This is what the Administration had asked for.

The Independent Petroleum Association of America reported late last month that crude imports would climb during the second quarter and contribute heavily toward an expected reduction of about half a million barrels a day in the U. S. market demand. Other contributing factors, it said, were oversupply of oil stemming from an early stock buildup and a seasonal decline in demand.

Further, Russell B. Brown, IPAA's general counsel, blamed imports for what he termed a 16 percent drop in number of exploratory drilling crews active during a 30-month period. He estimated, during an appearance before the Senate Labor subcommittee investigating causes of unemployment in various industries, that on the basis of one employe per 20 barrels a day of crude production 40,000 fewer workers currently are employed in the U. S. oil industry as a direct result of an 800,000-barrel-per-day hike in oil imports since World War II.

All attempts to solve the imports problem short of legislation have failed, Brown said. He listed four specific reasons for what he described as the failure of voluntary reduction of imports to work.

- Importing companies are unable to agree on individual reductions.
- Even if they should agree, they are fearful of violating anti-trust laws.
- Importing companies are under heavy pressure from foreign governments.
- Economic interests of the importing companies are on the side of large-volume imports.

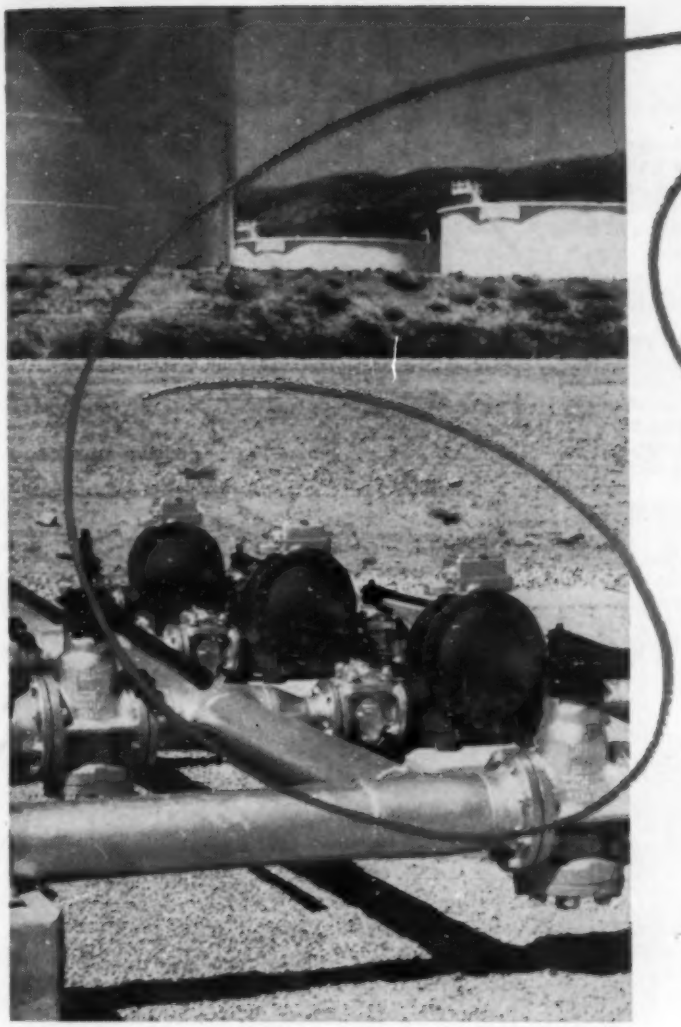
To illustrate the last point, Brown said the five largest American-based oil importing companies have only 11 percent of their oil reserves in the U. S. and 89 percent abroad.

"These five American companies," he added, "together with two foreign companies now dominate ownership of foreign oil reserves, excluding Russian controlled areas. These seven international oil companies now own more than 90 percent of all the foreign oil in the free world.

"This increasing concentration of economic power has serious and far-reaching implications for the American consumer. In addition, experience shows that increasing imports do not mean lower consumer prices, even in the short run."

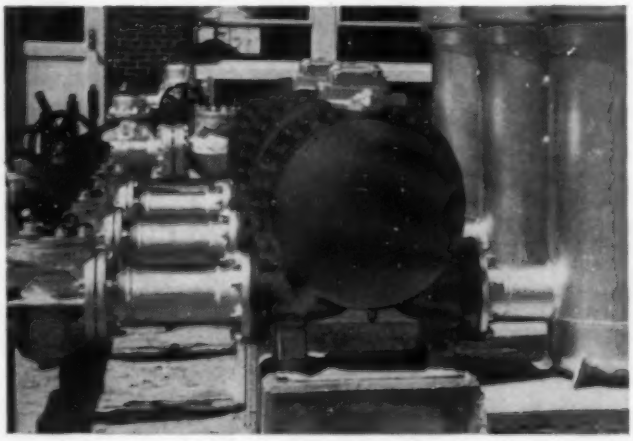
Prior to compromise efforts, the State Department circulated among congressmen and government agencies its reasons why legislative curbs on oil imports should not be undertaken. Its views ranged from (1) that there is a dearth of proof that the U. S. oil industry has suffered greatly from imports to (2) that U. S. investments abroad—almost a third of which are in oil—are vital to U. S. economy and foreign relations.

Meanwhile, the Texas Railroad Commission sliced 214,195 barrels daily from the state's May oil quota. In a longer-than-usual hearing, this month's allowable was put at an average of 3,072,150 barrels a day, with most fields having a 16-day schedule. Testimony heard by the commission indicated that many operators are facing disappearing markets, that some wells may have to be shut in this month for lack of crude purchasers.



Brodie BiRotor Meters installed on products pipeline at terminal take-off.

Installation of Brodie BiRotor Meters on products pipeline at head of line station.



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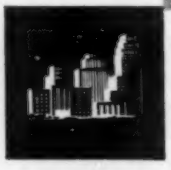

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Pipe Line Men

John S. Black, formerly with the Magnolia Pipe Line Company, has been elected president and director of **South Saskatchewan Pipe Line Company.** He has moved to Regina where he has opened an office for the company.

•

Grove Lawrence, vice president, **Southern California Gas Company,** has been selected to serve as second vice chairman of the Operating section of the American Gas Association for the remainder of the Association year. He succeeds Frederic A. Hough, Bechtel Corporation, who resigned in December.

Lawrence entered utility service with the Midway Gas Company in 1925 as a field engineer. This company was later acquired by the Southern California Gas Company. He was elected vice president, Gas Supply department, in 1951.

Lawrence has been active in A.G.A. affairs, serving for several years on the Technical Research Committee, the Committee on Underground Storage and the Operating Section Management Committee. As chairman, in 1953 and 1954, he guided work of the Transmission Committee in preparation of the extensive section on pipelining for the revised edition of the Gas Engineers Handbook. In 1954 he was co-chairman of the section's first Gas Supply, Transmission and Storage Conference.

•

Promotion of **Lowell E. Anderson** to division chief engineer for the **Service Pipe Line Company's** Wyoming division has been announced.

Anderson has headquarters at Casper. He will assist R. R. Strand, Wyoming division manager. The Wyoming division includes operations in Wyoming, North Dakota, Colorado and part of Nebraska.

Anderson was an engineer in the company's West Texas division before his promotion. He worked for Phillips Petroleum Company before joining Service Pipe Line Company in 1947. Starting as a junior engineer, he advanced to engineer in 1949. He had been at Lubbock, Texas, since 1953.

E. J. Tennyson

Lee May

Ed J. Tennyson, division superintendent for **Pan American Pipe Line Company** at Longview, Texas, has retired after 34 years of service with the company.

Tennyson began his employment with Stanolind Pipe Line Company, an affiliate of Pan American, in March, 1921, and transferred to the Pan American Pipe Line Company in 1940.

Lee May, division foreman at Longview, will succeed Tennyson as division superintendent. May has been with the company in various capacities since 1941.

In Pan American's Operating department, **P. F. Clark,** senior deliveryman at the Texas City terminal, has been transferred to the Houston office as safety supervisor; **E. R. Madding,** chief station engineer, Douglass Station, Northern division, has been transferred to Texas City to replace Clark; and **J. D. Parkerson**, engineer at Sabine Station, Longview, has been transferred and promoted to chief station engineer at Douglass.

•

H. H. Kuester has been appointed a director and elected a vice president of **Pasotex Pipe Line Company.** He has been manager of the Land and Lease division of Standard Oil Company of Texas, headquartered in Houston, for the past nine years. Since 1927 Kuester has been associated with Standard Oil Company of California in their Land and Lease division.

•

Arthur J. Helmbrecht, assistant to the president of **Buckeye Pipe Line Company,** New York City, has been elected a corporate vice president. The company operates crude oil transmission lines from Wood River, Ill., to Bayonne, N. J.

Election of **Ludlow Shonnard, Jr.** and **Jay Davis, Jr.,** as directors of **Southern Counties Gas Company** has been announced.

Shonnard is vice president in charge of the company's personnel, claims and industrial relations activities; Davis is vice president in charge of construction and distribution.

Shonnard joined Southern Counties in 1934. He was appointed personnel manager in 1942 and was elected vice president in 1953.

Davis began work with Southern Counties in 1938. He was named assistant to the vice president in 1948; manager of construction and distribution in 1953.

LASTING ECONOMY

"DO-NUT" Wm SEAL CASING BUSHING

EASY INSTALLATION:
TAPERED O. D. OF DO-NUT
IS DRIVEN INTO CASING END

SIZES: 6" PIPE AND SMALLER

STANDARD FOR DISTRIBUTION AND GATHERING LINES . . .

The DO-NUT Bushing, a solid, massive ring of synthetic rubber, slides easily over carrier pipe; THEN as tapered o. d. is driven into casing end, the flexible synthetic rubber compresses against pipe and casing forming a WATER TIGHT SEAL.

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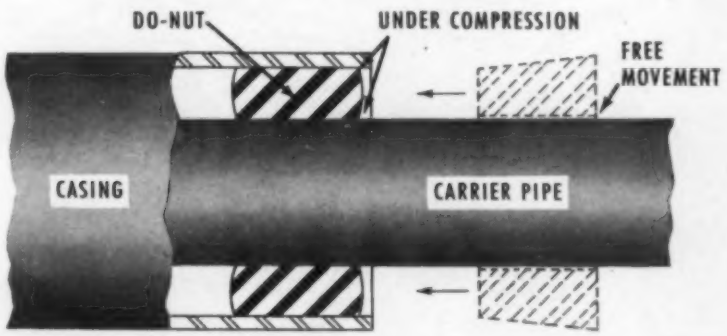

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Gulf Employes Represent 250 Years of Pipelining

More than 250 years of actual working time spent in the Gulf Oil Pipe Line department are represented by Houston area employes recently honored for their long service with the company. Left to right, they are Fred L. Benthall, chief master mechanic, General Manager's office; Grover L. Bevill, telegraph operator, Houston telegraph office; Cook E. Boykin, connection foreman, Almeda district; J. H. Russell, vice president in charge of the Domestic Pipe Line department, who presented the awards; Urbain Danes, truck driver, Almeda district; Henry A. Johns, chief engineer, Houston Pipe Line Engineering department; and Otto F. Zedler, chief electrical engineer, General Manager's office.

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R. G. Rice, formerly executive vice president of Tennessee Gas Transmission Company, recently resigned to enter business for himself. He will remain as board chairman of Tennessee Life Insurance Company, Tennessee Gas subsidiary, to which he was elected in February.

•

Two members have been added to the board of directors of **Minnesota Pipe Line Company.** Elected at the firm's annual stockholders' meeting in St. Paul were **O. H. Ingram** and **Edward C. Mishou.**

Ingram is president of Ingram Products Company, petroleum products marketing firm, with offices in St. Paul and operational facilities at Nashville and New Orleans.

Mishou is general manager of the pipe line firm, which recently completed construction of a 260-mile, 16-inch crude oil pipe line from Clearbrook, Minn., to Pine Bend. Mishou was formerly associated with the Interstate Oil Pipe Line Company of Shreveport, La.

•

Interstate Oil Pipe Line Company has announced the resignation of **George A. Wilson** as president and a member of the board of directors, and the election of **Phelan H. Hunter** to succeed Wilson as president. Interstate is an affiliate of **Standard Oil Company (New Jersey).**

P. H. Hunter

In other organization changes, **W. F. Davis** was elected a director; **J. W. Cason,** vice president and treasurer; **H. C. Bloomfield,** comptroller; and **Frank R. Clark, Jr.,** secretary.

Hunter began his career in the oil business in 1932 as an accountant with Standard Oil Company of Louisiana, now Esso Standard Oil Company, in New Orleans. He served as chief tax accountant of that company at Baton Rouge and in 1945 was made secretary, tax attorney and a director of the newly-formed Interstate Oil Pipe Line Company. He was elected treasurer of Interstate in 1950 and has served as secretary-treasurer since that time.

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Pipeline Contractors know Insley as a thoroughly dependable performer, capable of maintaining a maximum output regardless of the type of terrain. Put Insley pipeline experience to work for you—Let your Insley distributor show you "an Insley at work."

The Insley Manufacturing Corporation of Indianapolis has been manufacturing construction equipment since 1907. The Insley Line includes excavators and cranes, 5 to 30 ton capacity—rubber or crawler mounted. Let your Insley distributor show you "an Insley at work."

Warren Petroleum Corporation has formed a new Terminal and Transportation division under the managership of **Rex V. Phelps.**

Phelps will have five departments under his jurisdiction, each of which will continue to be managed by individuals who previously had directed their operations.

The Natural Gasoline Storage department will be managed by **John T. McKenna.** The Traffic department will be under the managership of **H. A. Busten,** and the Marine department will be managed by **C. R. Heaney.** The Engineering and Construction department will remain under the direct management of Phelps.

Phelps joined Warren in 1950 to handle engineering details on the construction of gas gathering lines for three natural gasoline plants. He was made engineer for the Liquefied Petroleum Gas division in 1943 and, since that time, has supervised the engineering and construction of bulk plants for distributors, the corporation's propane tanker and fleet of LP-Gas barges, marine distributing terminals, inland storage terminals and underground storage.

•

At a recent meeting of the board of directors, **John Clayton Jacobs, Jr.,** was elected a vice president of **Texas Eastern Transmission Corporation.** An executive vice president and a director of Wilcox Trend Gathering System, Inc., a subsidiary, he will continue to operate in those capacities and, in addition, will assume executive duties with Texas Eastern.

John C. Jacobs

Jacobs joined Wilcox in January, 1953. Both an attorney and a graduate engineer, he practiced law in Dallas from 1948 until 1953. Before that time he was employed by Creole Petroleum Corporation in Caracas, Venezuela, as supervisory engineer from 1944 to 1946. Prior to that he served as process engineer for Standard Oil Company of Louisiana.

W. M. Stephens has been appointed acting superintendent of construction for Texas Eastern. An engineer for the company since 1950, he will supervise the activities of the communications, compressor station, electrical, materials and pipe line sections of the company's Engineering department.

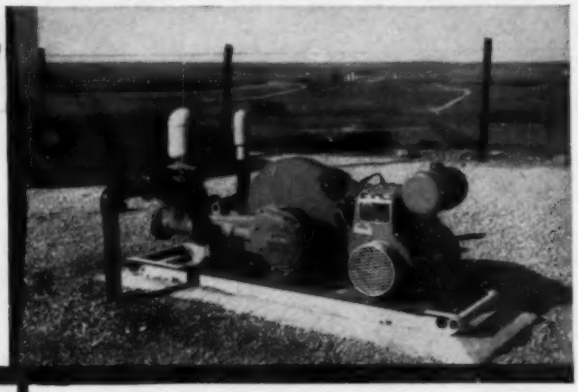
Before joining Texas Eastern, Stephens was employed as an engineer with Brown and Root of Houston. He has also been associated with the Construction Service Company, Hudson Engineering, Pan American Refining, Sinclair Refining, Humble Oil Company and Gulf Refining Company.

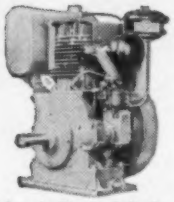
•

Lone Star Gas Company has formed a new Research and Development department. **Thomas S. Bacon,** chief engineer of the company's Transmission division since 1947, has been named director. He will coordinate the research activities of all departments and divisions of both Lone Star and Lone Star Producing Company. Bacon joined the company in 1931 as research engineer.

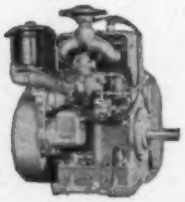
Efficient, Self-Sufficient

WISCONSIN-POWERED Pumping Unit on Duty in Cattle Country

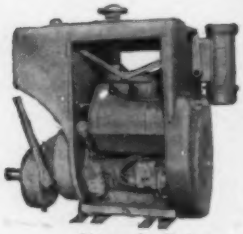




4-cycle Single Cylinder 3 to 9 hp.



2-cylinder 7 to 15 hp.



V-type 4-cylinder 15 to 36 hp.

Here is a Wisconsin-Powered oil pumping unit that is as *efficient* as it is *neat.* A standard Model AKND single cylinder Wisconsin Heavy-Duty Air-Cooled Engine operates a Goulds Reciprocating pump, delivering dependable, all-weather service the year 'round.

This installation is typical of the extremely compact, self-sufficient, foolproof Wisconsin-powered pumping units extensively used in oil field service. The unit shown above is working in the rich, active Little Chief Field of Oklahoma, where new, prolific producers are being developed. This is primarily cattle country and it is hazardous to have surface waste oil accumulations, so all oil is treated and re-treated — and it is in connection with this operation that this rugged Wisconsin-powered pumping unit is used.

Wisconsin Air-Cooled Engines used in heavy-duty oil field service are equipped with Stellite Exhaust Valves and Valve Seat Inserts and positive type Valve Rotators, assuring long engine life and lowest cost maintenance. Let us tell you about many other special oil field features.

More oil field utility units are powered by Wisconsin Heavy-Duty Air-Cooled Engines than any other make within a 3 to 36 hp. range — dominant preference that is based on actual performance records. You can't do better than to specify "Wisconsin Power" for *your* oil field equipment.

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A 8320-½-I

The appointment of **Frank E. Kalbaugh** as general manager of the newly-formed **Southern Pacific Pipe Lines, Inc.,** has been announced.

Frank E. Kalbaugh

Kalbaugh, former superintendent of the railroad's Salt Lake division, has been serving with the government as general manager of the Alaska Railroad. He joined Southern Pacific in 1919 as a clerk at Bakersfield, Calif., and advanced through operating department positions at various locations on the railroad's lines.

He became assistant superintendent of the Western division in 1944, superintendent of transportation at San Francisco in 1947 and superintendent of the Salt Lake division in 1948. Since his appointment as general manager of the government-owned Alaska Railroad, in September 1953, Kalbaugh has been on leave from Southern Pacific.

His office will be in the Pacific Electric Building, Los Angeles.

•

The board of directors of the **Trans-Northern Pipe Line Company** has announced the appointment of **L. R. Dickinson** as president. Dickinson joined Trans-Northern in 1953 as vice president and general manager.

L. R. Dickinson

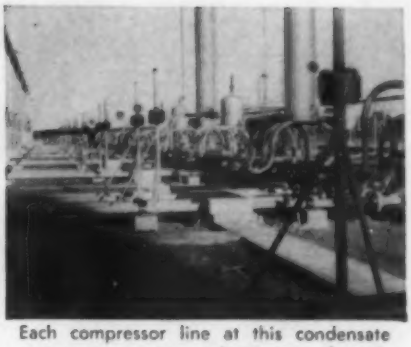
Born and educated in Kansas, he had held several key enginering positions during his 22 years in pipe line work in the U. S. before joining Trans-Northern.

•

Howard T. Scranton Transcontinental Gas Pipe Line Corporation, has transferred from Newark, N. J., to Transco's offices in Decatur, Ga.

Scranton is the assistant to Transco's vice president, Eastern division. He will continue in that capacity and will be in charge of customer contacts in the southern sales area for the natural gas transmission firm.

BS&B Safety Head used as a final relief device on a high pressure well-head. Platform and stair are BS&B Safwalk.

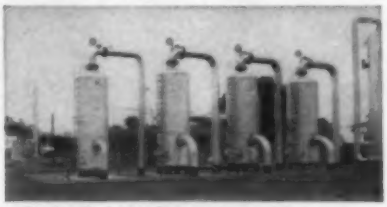


Each compressor line at this condensate recovery—pressure maintenance plant is BS&B Safety Head equipped.

BS&B Safety Heads... Sentinels of the Oilfields!

Wherever you travel in the oil industry today, you are likely to see BS&B Safety Heads performing sentinel duty over millions of dollars worth of property and equipment and countless human lives! You'll find them on oil and gas separators, emulsion treaters, gas scrubbers and heat exchanger shells . . . on storage tanks, refinery pressure vessels, in gas compressor stations and along the pipelines. They are there for one purpose only—to provide *safe, instantaneous relief* from overpressure, should it occur in the system!

If you'd like a catalog or more information about BS&B Safety Heads, contact your nearest BS&B Representative...or write to us direct.



Each of these four gas scrubbers at a southern natural gasoline plant is protected by a BS&B Safety Head.

BS&B Safety Head on high pressure gas scrubber, as seen on a typical offshore platform in the Gulf of Mexico.

In this central separator battery, each vessel has a BS&B Safety Head for protection from overpressure.

THE "CIRCUIT-BREAKER" of Pressured Systems

For Better Regulation of Pressures, Temperatures Liquid Levels or Flow, Equip Your Process With BS&B AUTOMATIC CONTROLS!

BS&B — Another Example of Product Leadership

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-EP5
7500 East 12th Street
Kansas City 26, Missouri

For more data on advertised products, use Readers' Service Cards, last page.

Styles illustrated
50-00 Jacket
51-05 Pants
53-15 Hat

Protective Clothing by *Sawyer*

Wears like iron — takes endless rubbing, scraping, snagging, and still gives full protection.

100% Waterproof — made with top quality base fabric saturation-coated first and then coated with 6 coats of Neoprene Latex.

Positively will not blister, crack or peel. Its longer lasting quality means greater economy.

Also: Three-quarter and long coats, aprons, coveralls and many other styles. All clothing made in black or yellow.

FROG BRAND

THE H.M. SAWYER & SON CO.

Cambridge, Massachusetts

What's Happening

AMONG SERVICE AND SUPPLY MEN

Johnston Expansion Planned By Emsco Manufacturing

General expansion of the services and facilities of Johnston Pump Company, one of the large vertical turbine manufacturers, and appointment of A. H. Miller, vice president of Emsco Manufacturing Company, as general manager, have been announced. Emsco acquired the assets of Johnston Pump Company January 31.

A. H. Miller

The sales engineering staff of Johnston will be increased, and the dealer organization expanded to service agricultural, municipal and industrial customers throughout the U. S. and foreign countries.

Miller started with Emsco in 1929 and moved up in the organization in various capacities. He is vice president, secretary and treasurer of Emsco.

Chessin Joins Van der Horst As Assistant Research Director

Dr. Hyman Chessin is new assistant director of research and development for the Van der Horst Corporation. Prior to joining the company, he taught at Kenyon College and conducted research at the University of Arkansas.

In his new position, Chessin will assist in research for product improvement and development, in addition to conducting research into broader applications for the corporation's Porus-Krome and Vanderloy electroplating processes.

Clear Span Engineering Company Opens Washington Branch Office

The opening of a new branch office in Washington, D. C. for the Clear Span Engineering Company of Houston, has been announced. The move will enable them to be informed immediately on laws and regulations affecting bridge and pipe line construction and will put them in a better position to offer consulting services.

The company has gained national attention in the field of bridge building, having designed, supervised or built 11 major bridges during the past 18 months.

L. F. Corwin, vice president of Clear Span, is in charge of the Washington office.

New officers of the company recently announced include Weldon F. Appelt, elected president and treasurer; and Dr. W. P. Bonin and L. F. Corwin chosen vice presidents. Julie McDonald was elected secretary.

H. B. ZACHRY CO.

General Contractors

PIPE LINE DEPARTMENT TRANSIT TOWER

SAN ANTONIO, TEXAS

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Skill, Integrity and Responsibility

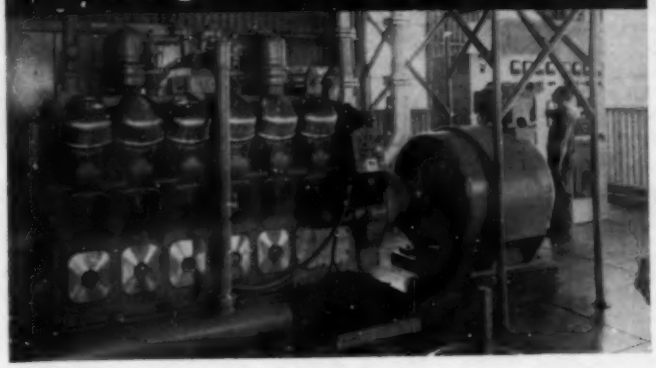
Constructors of

PIPE LINES

Oil Field Stations **Electrical Installations**

For more data on advertised products, use Readers' Service Cards, last page.

DEPENDABLE POWER-
Ready When Needed



When you need power you can always depend on—you need a Le Roi Engine. They're famous for dependability, long life and efficient service. They're available in sizes that are right for your particular requirements.

Whenever you have a power problem call on Southern Engine & Pump Company. Let our 46 years experience, competent engineers and skilled mechanics help you solve it.

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ENGINE & PUMP COMPANY

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STANDARD OF THE INDUSTRY . . .
for cutting steel or cast iron pipe . . .

THE
ALSTON
Rachet
PIPE CUTTER

There's none better for SPEED, SAFETY, POWER, ACCURACY and ECONOMY. It eliminates dangerous sparks . . . broken cutters; rollers hold pipe taut after cutting. It's easy on and off pipe . . . will cut 10" pipe in 12 min. Patented roller guides. Rachet makes it easy to work in close places.

A size for every requirement . . . write for details, literature and prices.

ALSTON MANUFACTURING COMPANY
P. O. Box 707 **Phone 226**
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Stop Corrosion!
WITH *Harco* CATHODIC PROTECTION SYSTEMS

Industry's No. 1 Enemy can be stopped by HARCO.

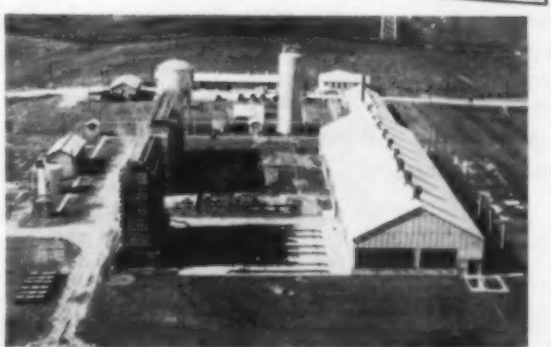
Now there is a "police force" ready to help you in stopping thief corrosion. Harco engineers are defeating the ravages of electrolytic corrosion of underground and underwater piping.

HARCO JOB-ENGINEERED SYSTEMS provide necessary testing, drawings, materials, installation and maintenance.

HARCO INSTALLATION CONTRACTING is completed to customers specifications and covers as much of total job as required. HARCO will assist in evaluation and solution of your particular problems.

Stop the thief Corrosion Now!
Specify HARCO . . . FIRST IN THE FIELD OF CATHODIC PROTECTION.

Write today for catalog or call MOntrose 2-2080



Natural Gas Pumping Station Utilizes Harco-Engineered Cathodic Protective System to Eliminate Corrosion in Underground Lines

THE *Harco* CORPORATION *Cathodic Protection Division*
17019 Broadway • Cleveland, Ohio 6100-HC

Cleveland • New York • Chicago • Philadelphia • Detroit • St. Louis • Louisville • Minneapolis • Oklahoma City • Los Angeles • Seattle • Houston • Atlanta • Lynchburg • Pittsburgh • Albany • Davenport • Toronto, Canada

R. A. Fenoglio

W. C. Sandland

Reilly Tar & Chemical Announces Staff Changes

Rudolph A. Fenoglio has been named assistant plant manager of the Maywood, Indianapolis, multiple plant operation of Reilly Tar & Chemical Corporation. He has been a member of the Engineering department staff of Reilly for nine years during which time he was in charge of the construction of the Lone Star, Texas, plant.

William C. Sandland has been made sales representative for the Houston area. He was formerly with Specialty Sand Company of Houston as a sales engineer.

Sandland will have his headquarters at Reilly's Houston offices, 2009 Fannin Street.

Allis-Chalmers Assigns Reynolds To Houston District Office

Robert A. Reynolds has been assigned to the Houston district office of Allis-Chalmers General Machinery division as a sales representative. He was formerly an application engineer in the rectifier sales group at Allis-Chalmers West Allis Works.

V. V. Malcom Appointed Perrault Vice President

V. V. Malcom, sales manager of the Philip Carey Manufacturing Company, has been appointed vice president and general manager of Perrault Equipment Company, a leading pipe line equipment and supply firm.

V. V. Malcom

Malcom joined the Carey firm as a field engineer in 1927. He served them continuously in various capacities until the present change. He was associated with pipe line construction throughout this period, having designed, manufactured and marketed a number of materials commonly used in the industry.

Frank Wheatley Supply Announces Two Appointments

Ed Nolan, Frank Wheatley Supply Company representative, has been moved from Lafayette to Bartlesville. He will serve the Bartlesville and Kansas areas.

Concurrently, the company announced that Bob White, veteran supply man, is now associated with them and will work out of the Houston branch, serving the Gulf Coast and southern Louisiana.

Pacific Coast Borax Co. Announces Personnel Changes

Pacific Coast Borax Co., division of Borax Consolidated, Limited, has announced the following personnel changes:

L. L. Fusby has been appointed production manager, with headquarters in the Los Angeles office. He will have over-all charge of the production facilities at Boron and Wilmington, Calif., as well as having charge of the design and operation of the pilot plants. He was formerly general superintendent at Boron.

W. J. Diffley has been appointed superintendent of the Boron operations. He has been a chemical engineer with the company, and production manager at the Wilmington plant for the past seven years.

Dr. D. S. Taylor has been appointed director of industrial research, responsible to the vice president in charge of research.

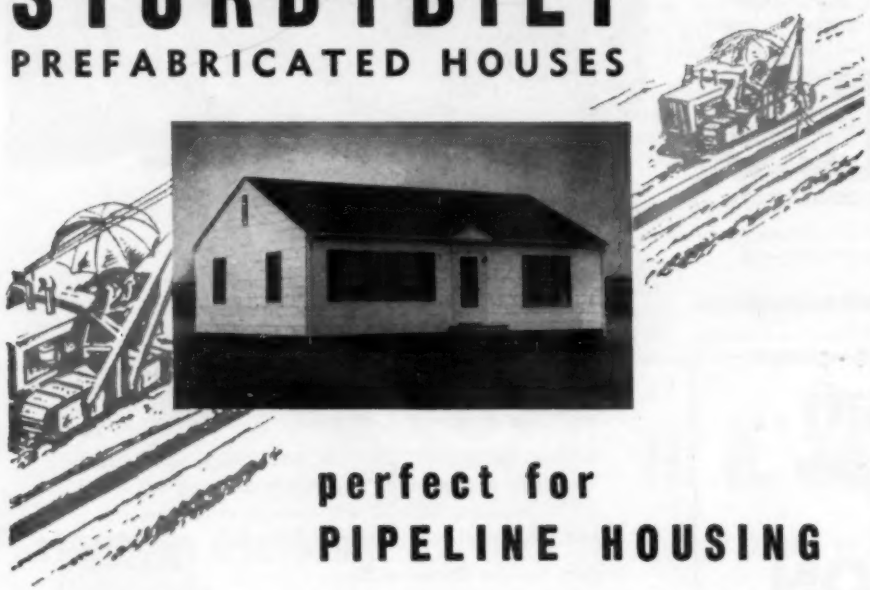
Lincoln Appoints Stringham Engineering Vice President

The Board of Directors of The Lincoln Electric Company has announced the appointment of L. K. Stringham as vice president in charge of engineering. He has been chief engineer for the company since 1951. George Landis, who has been the engineering vice president, was appointed vice president in charge of research.

Stringham joined the Lincoln Engineering department in 1933, and his experience in the department he now heads has included all phases of engineering: experimental research, product development, testing and application.

Prior to his appointment as chief engineer in 1951, Stringham was director of welding development where he was responsible for the development of applications for welding processes and equipment. He is a member of the board of directors of the company.

STURDYBILT
PREFABRICATED HOUSES



perfect for
PIPELINE HOUSING

When pipeline camps are needed far away from cities or towns, STURDYBILT houses will fill your housing need. The prefabricated sections are loaded on trucks, moved to your site and erected in days instead of weeks.

Many leading pipeline companies have proved to themselves that STURDYBILT Houses are the perfect answer to pipeline housing problems. Ask about our purchase or leasing plan.

MANUFACTURERS OF SPECIAL MILLWORK: DISTRIBUTORS OF CURTIS WOODWORK, JOHNS-MANVILLE BUILDING MATERIALS

STURDYBILT PREFABRICATED, DEMOUNTABLE HOUSES

SOUTHERN MILL & MANUFACTURING CO. • TULSA, OKLAHOMA

STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

R. A. Darling

Melvin S. Kenady

Manufacturers Representatives Form Darling-Kenady Company

Establishment of Darling-Kenady Company, manufacturers representatives specializing in oil industry equipment in Denver, has been announced by R. A. (Bud) Darling and Melvin S. (Mel) Kenady. Both men were associated with the Tulsa branch of Cooper-Bessemer Corporation as sales engineers before the establishment of their own offices in Denver.

Territory covered by the firm embraces the greater part of the Rocky Mountain region with special emphasis placed on service to the gas, gasoline and refining industries.

Offices have been established in the Mining Exchange Building, 15th and Arapahoe Streets, Denver.

Bucyrus-Erie Names Goree Assistant Sales Manager

Edwin T. Goree has been appointed assistant sales manager, Excavator Distributors, for Bucyrus-Erie Co. He will assist R. C. Adams, named sales manager of the company's widespread distributor organization upon the promotion of L. E. MacDonald to general sales manager.

Edwin T. Goree

Goree served as mining engineer for Pato Consolidated Gold, Colombia, South America, from 1937 to 1940. He was employed by Pacific Steel and Copper as manager in 1945, and, in 1947, he joined B-E to receive special training in export sales. In representing the company's Export Sales department, he traveled extensively in Mexico, Central America and South America. In 1951 he was named B-E field representative for Mexico.

Sewell Elected Vice President Of Garlock Packing Company

Board of directors of Garlock Packing Company recently elected J. B. Sewell vice president of the company. Sewell started with The Garlock Packing Company of Canada, Ltd., in 1935 as a sales representative in the Montreal area. In 1947 he was elected vice president of that company, moving to Toronto in 1951.

In October, 1954, Sewell was transferred to the U. S. and appointed general sales manager of the parent company with over-all direction of sales in both Canada and the U. S. As vice president he will continue directing sales operation of the company.

Why
do most users
prefer and buy the genuine
RIDGID
PIPE WRENCH?

It's easiest to work with... perfect balance . . . comfort-grip I-beam handle . . . handy pipe scale on hookjaw . . . easy-spinning adjusting nut . . . clean grip on pipe, no slip or lock.

It lasts longer... first guaranteed housing, won't break or bind . . . ever. Every wrench individually tested before shipment . . . and millions of them in use. Sizes 6" to 60"—end pattern, 6" to 36".

For the most for your money, buy RIDGID . . . Your local Supply House stocks them for you, delivers them fast!

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

For more data on advertised products, use Readers' Service Cards, last page.

T. M. Lamberth to Manage Cooper-Bessemer Office

The promotion of T. M. Lamberth, Jr., as manager of Cooper-Bessemer's Shreveport branch office has been announced. Lamberth fills the position formerly held by the late A. K. De France.

As branch manager, Lamberth will direct both sales and application engineering of engine-driven and motor-driven compressors, as well as diesel, gas-diesel and spark-ignited gas engines.

Lamberth was formerly sales engineer with Joseph A. Coy Company and Arrow Industrial Manufacturing Company, both manufacturers of heat transfer equipment. His assignment to the Shreveport office follows extensive service with Cooper-Bessemer's engineering and manufacturing facilities in Mount Vernon, Ohio.

R. L. Borchardt

Roy H. Olson

Olson and Borchardt Promoted By Motorola Communications

Roy H. Olson has been appointed director of engineering in the Communications & Electronics division of Motorola, Inc. In this capacity he will direct the technical activity of the division's industrial products department.

In radio 20 years, Olson has been with Motorola since 1951 when he joined the company's Phoenix Research Laboratory as engineering section leader. He was with Collins Radio Company 13 years, and later operated his own manufacturing and consulting firm before coming to Motorola.

Since joining Motorola, Olson has been co-ordinator of National Bureau of Standards missile fuse projects and project leader for special military development tasks.

Robert L. Borchardt has been appointed assistant manager of Motorola's Technical Information Center in the company's Communications and Electronics division. He will supervise all staff writing in the division's public relations and sales promotion activity, assuming the duties of Darrel E. Knight who has resigned.

Borchardt formerly was field information supervisor in charge of service aids, sales correspondence and technical publications. He has been with Motorola since 1950.

Pipe Line Technologists Formed As C.R.C. Engineering Dissolved

Dissolution of the C.R.C. Engineering Company and formation of a new engineering firm, Pipe Line Technologists, with same management and personnel under a sole proprietorship, has has been announced. Herbert E. Fisher, former co-owner and managing director of C.R.C., is president of the new firm.

Herbert E. Fisher

Home office of the pipe line design engineering company is in Houston, with branch offices in New York City and Calgary, Alberta, Canada.

The firm will continue to offer complete engineering services for crude oil, natural gas and petroleum products pipe line systems.

Crutcher-Rolfs-Cummings, Inc., under the direction of A. S. Crutcher and Jim Cummings will deal exclusively in the manufacturing, sale and rental of pipe line equipment.

Pipe Line Technologists will continue to manage and supervise operations of Kaneb Pipe Line and Augusta Pipe Line Companies in Kansas and Nebraska.

Douglas Hopper to Head G. E. Welding Department

Douglas A. Hopper has been named general manager of General Electric's Welding department. Formerly manager of G. E.'s Warehousing and Field Services, Large Lamp department, Hopper succeeds Raymond C. Freeman, who has been appointed manager, Engineering and Operations, Atomic Power Equipment department, at Schenectady.

Hopper joined General Electric at Schenectady in 1933 on the business training course. Following service as a disbursement clerk, he became a traveling auditor in 1935 and, after service in other responsibilities, transferred to Newark, N. J., as manager of the Service District Lamp division in 1943. He was named manager of the Service District Lamp division at Dallas in 1944.

Everything for the Pipeliner
COATING & WRAPPING MACHINES
Line Traveling Over-the Ditch or Stationary Yard and Railhead types
Machines for every job are available — for pipe from 2" to 36", for any coating and wrapping combination from single-coat, single wrap to double-coat double-wrap. Perrault's years of field experience have developed the most efficient, most dependable equipment you can find. And Perrault's earnest desire to give customer satisfaction assures you of the best service to be had. You'll do better when you call Perrault Equipment Company.
Sole Owner, W. O. DIXON
ALSO: Cleaning and priming machines — line traveling or stationary. Glass Pipe Wrap, Asbestos Felt Wrap, Kraft Wrap, and Rock Shield. Tar-Heating Kettles, Burners, Patch Pots and Accessories.
AND: Pneumatic-Tired Lowering-In Cradles, Adjustable Pipe Cradles, Five-roller Cradles, Tongs, Hooks, Blocks, Belts, Slings, Line-up Clamps, Hand Tools, Supplies and Equipment of every sort.
PERRAULT Equipment COMPANY
TELEPHONE 5-1103 • 1130 NORTH BOSTON • TULSA 6, OKLAHOMA
EXPORT OFFICE: 30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y. PHONE CIRCLE 6-6260

Pazdral Names McHenry Dallas Sales Engineer

Tod Pazdral Pipeline Specialties Company has announced the appointment of Richard Lee McHenry as sales engineer for the Dallas area. In addition to offering consulting service, the firm distributes equipment for construction and maintenance of pipe lines under the trade name Topaz.

R. L. McHenry

McHenry has worked with Tennessee Gas Transmission Company in Louisiana and for Transcontinental Gas Pipe Line Corporation in New York and New Jersey on river crossing construction.

NEW BOOKS

TENTATIVE STANDARD FOR FIELD WELDING OF PIPE LINES, API Standard 1104, Third Edition, American Petroleum Institute, 50 West 50th Street, New York 20. 50 cents.

This revised edition of the API standard incorporates certain changes resulting from comments on the second edition issued in February, 1954. Principal changes are in the welding section. The important additions to this revision are the Procedure Qualification requirement and sketches of test specimens.

The standard and its latest revision were prepared by a committee on which serve representatives from the American Gas Association, Pipe Line Contractors Association, Pipe Manufacturers and the American Petroleum Institute. The American Welding Society and the Society for Nondestructive Testing now have official representation on this committee.

Copies may be ordered from J. A. McNally.

FIELD HANDLING OF NATURAL GAS, Petroleum Extension Service, The University of Texas Division of Extension, Austin.

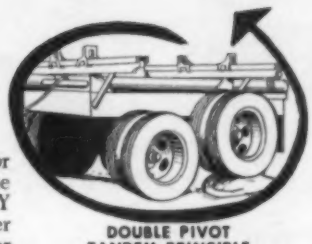
A summary presentation of practices for field handling of natural gas, this manual has been prepared primarily to aid field men who daily deal with the problems of production and transportation.

Well illustrated, the manual includes discussions on growth of the natural gas industry, conservation of natural gas, the natural gas operator, gas piping, valves and fittings, flow system equipment, control instruments, prevention of hydrates, separation of gas and liquids, cold-separation units and orifice meters. Highly technical matters which would not contribute to the further education of those who have the problems first hand have been omitted.

The information was compiled under the guidance of a Special Formulating Committee appointed by the American Petroleum Institute, Division of Production.

TOP QUALITY PIPELINE TRAILER

THE LOADCRAFT **PIPELINER**



DOUBLE PIVOT TANDEM PRINCIPLE

At last here's a top-quality tandem trailer for the pipeline industry that is really built to take the cross-country hikes. The axles will STAY in alignment. Quality that has made Spencer Trailers popular with the oil fraternity for over 38 years goes into each of these jobs.

Double pivot tandem keeps load in balance in rough terrain, reduces wear and tear on axles and tires Hi-tensile pressed steel frame, wood surface block-type bolster plus other exclusive features gives you the kind of trailer you have needed .. and at a price that is less than you would expect to pay for such high quality.

Spencer-Safford LOADCRAFT
AUGUSTA, KANSAS

Please send me information on your
Pipeliner___ Pole Trailer___ Oil Field Float___
NAME_____
ADDRESS_____
TOWN_____STATE_____

More comments on this new Handbook:

"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

Send for your FREE copy of the New Petroleum Book Catalog which describes the nature and contents of many books pertaining to the Petroleum Industry.

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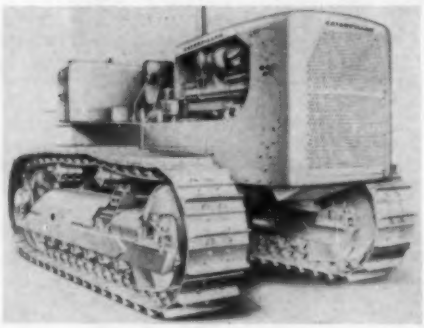
Book Department
GULF PUBLISHING COMPANY
P. O. BOX 2608
HOUSTON 1, TEXAS

For more data on advertised products, use Readers' Service Cards, last page.

What's New in Equipment

for the Pipe Line Industry



Crawler Tractor

A 230-drawbar horsepower crawler tractor with turbocharged engine, product of Caterpillar Tractor Company, is now in production. The big D9 has a new 6¼ by 8, six-cylinder Cat Diesel engine equipped with a turbocharger. The tractor also has Caterpillar's oil-type clutch or optionally a torque converter, in-seat starting and hydraulic track adjustment. General appearance will conform to other models of Cat crawlers. Length is 17 feet, 10 inches; width, 9 feet, 11 inches; height (excluding exhaust pipe and air cleaner), 8 feet, 9 inches. Ground clearance is 21 inches.

Ninety-inch gage is standard as is a seven-roller track frame and fixed drawbar. A console-type control panel, seat design and location and arrangement of operating controls make a flat, relatively open deck.

Speeds up to 7.8 miles per hour with three speeds forward and two in reverse are provided. The direct drive has six speeds forward and six in reverse ranging from 1.6 to 6.8 mph. With direct drive transmission, drawbar pounds pull of 60,860 pounds are possible with adequate weight and traction.

The conventional-drive D9 will weigh 56,200 pounds and the torque converter model, 56,650 pounds.

For more data circle **No. E1** on Readers' Service Card, last page this issue.

Rotary Air Compressor

A new water-cooled rotary air compressor has been announced by Gardner-Denver Company. Portable, the compressor has a capacity of 600 cubic feet per minute, and can operate under weather conditions ranging from 40° F. below zero to 115° F. above.

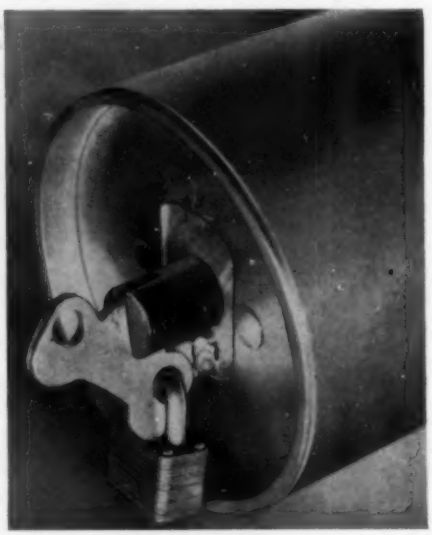
The water-circulating system is automatic and maintains the most efficient operating temperature for both engine and compressor. In cold weather, warm water from the engine heats up the compressor oil system before the compressor starts to turn. A hydroshift clutch is provided between the engine and compressor so that the compressor load may be disengaged for easier engine starting in cold weather.

Other features include a special unit which prevents contamination of the oil by moisture condensation, units which remove oil from the air, an automatic speed control and inspection covers which provide ready access to all parts.

Weight of the Rotary 600 is 8700 pounds. Width is 5 feet, 11 inches; height is 8 feet; length is 11 feet, 2 inches. Automotive-type running gear provides a short turning radius of 14 feet.

(This item supplements Gardner-Denver Company data on Pages 1781-1800 of the Composite Catalog.)

For more data circle **No. E2** on Readers' Service Card, last page this issue.

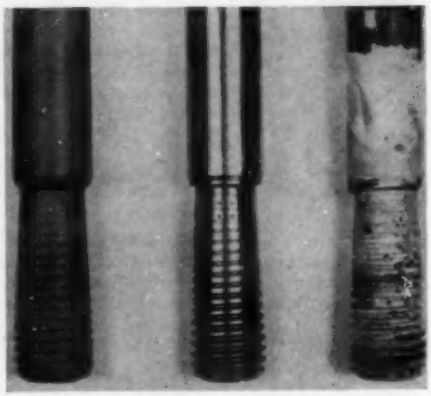


Pipe Cap Lock

Development of a cap which closes and locks the ends of pipe lines while workmen are away has been announced by B. J. Stansbury, oil tool manufacturer and operator. The cap lock is held firmly onto the end of the pipe by a pair of expanding elbows which screw out to lock tightly against two opposite inside walls of the pipe. To insure that the unit is not manipulated loose, a lock can be applied to prevent movement of the holding mechanism.

Caps for the line pipe lock will be furnished in a variety of sizes from four inches to 12 inches. One lock unit, with various sizes of caps, can be used on several corresponding sizes of pipe.

For more data circle **No. E3** on Readers' Service Card, last page this issue.



Vinyl Mastic Coating

A new vinyl mastic protective coating that requires only a one-coat application has been developed by Amercoat Corporation. It can be applied at a thickness of ten mils in one double-pass spray coat, and produces a heavy film thickness without sacrificing vinyl chemical and moisture resistance. The coating is applied with conventional industrial spray equipment. It also reduces the possibility of edge corrosion because its heavy, impervious film provides a corrosion resistant barrier around edges and sharp objects which always have been trouble spots in industrial maintenance painting.

New properties of the coating are the result of an increased vinyl resin content made possible by new combinations of solvents.

Above, bolt on left has one coat of primer and one coat of the No. 87 vinyl mastic. Center bolt is uncoated to show surface detail. Bolt on right has three coats of a good vinyl coating. Both coated bolts were exposed to severe salt spray test for the same period of time.

For more data circle **No. E4** on Readers' Service Card, last page this issue.

Expanded Seamless Pipe

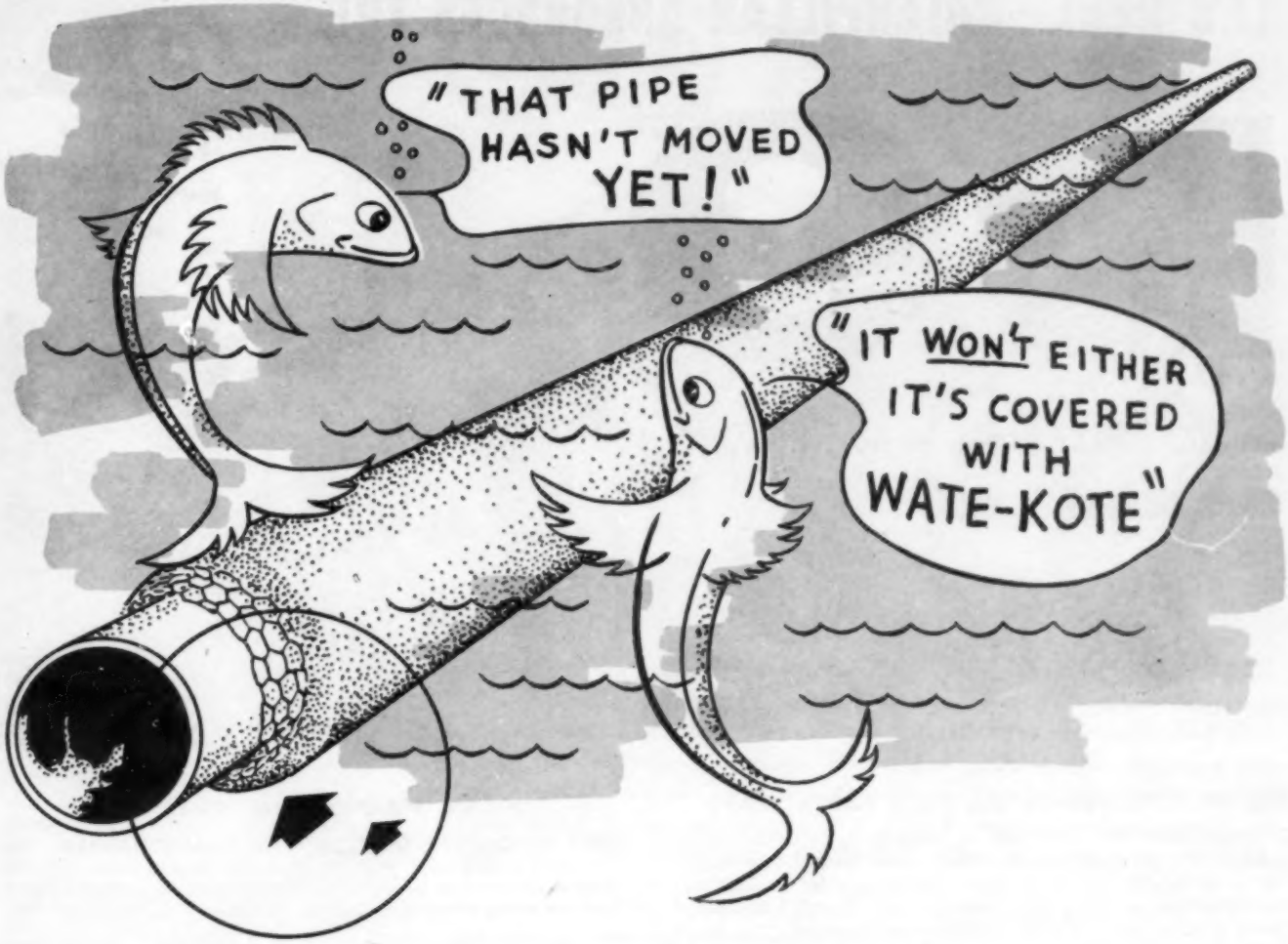
Shipment of the first commercial order for cold expanded seamless pipe is now being made from the Lorain Works of U. S. Steel Corporation's National Tube division.

The pipe combines the safety of seamless walls without welds and the uniform high strength with excellent weldability of mechanical cold work.

Equipment at the Lorain expansion plant is designed to expand pipe in the size range of 16-inch to 26-inch outside diameter. Pipe is expanded when a two-piece plug, attached to a mandrel bar and powered by a 500 horsepower motor, is forced through the pipe at a rated 300,000-pound thrust. A water soluble lubricant is applied to the inside surface of the pipe immediately ahead of the plug to reduce friction. The expanding process shortens the pipe by several inches, and thickness of the pipe wall is only slightly reduced. Straightening and inspection follow expansion.

For more data circle **No. E5** on Readers' Service Card, last page this issue.

Save time! Keep informed! Circle numbers on Reader Service Cards, last page this issue.



No fish story this. WATE-KOTED pipe is designed to be put on bottom—and to stay on bottom!

The reason? WATE-KOTE's high strength, high density, and heavy weight concrete, uniformly reinforced, results in a coating that is almost as strong as the pipe itself. That's why—for laying weighted pipe under water or in marshy ground—WATE-KOTE is the **best** and **most economical** method on the market today. Reason-in-a-clamshell why WATE-KOTE is specified by almost every pipeline company that has used it.

When you can get the very **best—for less**—why not take advantage of this proven protection for water crossings or marshy ground? Once tried—the results will make WATE-KOTE standard procedure on your pipeline jobs.

RR ROSSON-RICHARDS

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For more data on advertised products, use Readers' Service Cards, last page.

IT'S HERE—CATERPILLAR ANNOUNCES THE

D9

230 HP (Drawbar)

56,200 LB.

Another example of Caterpillar leadership in action!

THE D9...PROVEN IN THE FIELD FOR A YEAR!

Though new, the CAT* D9 is already a veteran. After exhaustive proving tests, several D9s have been tested for over 19,128 hours on the toughest jobs in logging, construction, mining and quarry work. These jobs tested every square inch of this mighty new machine. The word from the field: "By far the best big tractor ever made."

RUGGED—AND EASY TO SERVICE!

From its one-piece welded steering clutch case-frame assembly, to its track shoes hardened by the "Water Quench" process, the D9 is the toughest crawler built. And, it's designed for easy servicing. Oil clutch, torque converter, transmission case and steering clutches can each be removed individually without disturbing other components. Hydraulic track adjusters make service easier, too.

EASY TO OPERATE!

—The independent "live shaft" drive for cable controls makes operation smoother, easier.

—Hydraulic boosters provide power steering *and* braking.

—Adjustable seat, all-around visibility, easy access to all controls make operator's job simpler.

—7-roller track frame improves stability and ride.

—New starting engine has electric starting system and simple single-lever control for easy operation from the seat and insures fast starts in all weather.

All in all, the new D9 sets a new standard of big, money-making, earthmoving performance. Get the full facts about this rugged giant from your Caterpillar Dealer.

FAST FACTS ON THE D9

FIRST TRACK-TYPE TRACTOR WITH TURBOCHARGER! The D9's new Turbocharger is driven by the engine exhaust, utilizing energy which would otherwise be lost. Packs air into engine according to engine *load*, not speed; means more working HP — greater performance.

CHOICE OF TORQUE CONVERTER OR DIRECT DRIVE! Two types of drive are available, the exclusive Caterpillar oil clutch with six-speed (forward and reverse) transmission or a three-stage torque converter with 5:1 torque ratio. The transmission used with the torque converter has three speeds forward, two reverse. This option enables you to match the drive you want to your job requirements.

COMPLETELY NEW 286-HP ENGINE! In addition to the Turbocharger, the powerful new D9 Engine features a 6¼" bore and 8" stroke and runs at 1200 r.p.m. Long life and dependability are promoted by stationary oil jet piston cooling; short, rigid valve push rods give smooth, accurate valve action; "Hi-Electro" hardened gear at rear of crankshaft drives timing gears and accessories; other advanced features.

WIDE RANGE OF OPERATING SPEEDS!

Torque converter: 3 speeds forward, 0 to 4.1 m.p.h., 0 to 5.7 m.p.h., 0 to 7.8 m.p.h. • 2 speeds reverse, 0 to 4.1 m.p.h., 0 to 7.8 m.p.h.

Direct drive: 6 speeds forward, 1.6, 2.1, 2.9, 3.9, 5.0, 6.8 m.p.h. 6 speeds reverse, same

CONSTANT-POWER DRIVE FOR REAR-MOUNTED EQUIPMENT! You always have power for cable controls, direct from the engine's rear power take-off. This makes cable control operation completely independent of flywheel clutch or torque converter, boosts operating efficiency.

EQUIPMENT: New Caterpillar-built 'Dozers for the D9: the No. 9S Bulldozer, modified straight blade; the No. 9A Bulldozer, angling blade. New Caterpillar-built Cable Controls: the No. 29 rear-mounted, double drum; the No. 30 front-mounted, single drum.

SPECIFICATIONS: Length 17' 10¾", width 9' 11¼", height 8' 9", gauge 90", approx. wt. 54,000 lb. dry — 56,200 lb. operating.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

MAIL TODAY!

CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.

I'd like more information on the D9.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

THE D9— NEW KING OF THE CRAWLERS

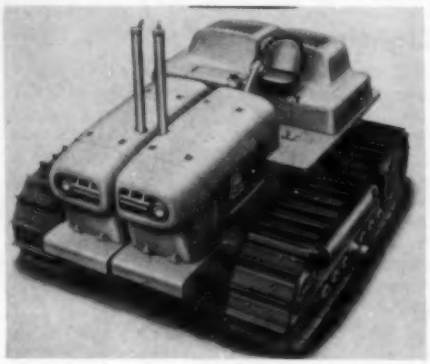
NEW EQUIPMENT

Visible Wedge Valve

A new valve, recently placed on the market by Hamer Valves, Inc., is designed to permit full-view visibility of the wedge at all times. One glance can determine whether the line is full open or full closed. The metal-to-metal fit of the wedge and seats, augmented by seal rings, provides a complete line shut-off.

In addition, valve seats are an integral part of the body. Both wedge and seats have stainless trim to prevent corrosion. Operator has complete control of the wedge at all times. The wedge rotates at a touch, and there is no lifting necessary to reverse it. No line movement is necessary to open or close the valve. Hand wheel operation enables operator to open or close line in less than a minute.

For more data circle **No. E6** on Readers' Service Card, last page this issue.



Twin-Power Tractor

Outstanding feature of the TC-12 twin-power crawler tractor, product of the Euclid division of General Motors Corporation, is the use of two 194 horsepower Series 6-71 General Motors Diesels, each driving one of the tracks through separate torqmatic drives consisting of torque converter and semi-automatic transmission.

The first new tractor design in the construction equipment industry in many years, the new tractor has 40 percent greater weight and 80 percent more horsepower than tractors currently in use. It will push-load rubber-tired scrapers faster and permit larger scrapers to be utilized.

Changing from one speed range to another is done under full power. Three speed ranges, forward and reverse, provide speeds from 1.5 miles per hour to 8.3 mph. Maintaining proper track tension is automatic. Each half of the tractor, a separate unit joined to the other by a single transverse shaft, is free to move seven inches up or down to maintain better contact and traction on rough ground. For shipping purposes, the tractor can be separated into the two halves. Two radiators, each having 28 gallons capacity, are located in the rear of the tractor.

Track gage is 110 inches, over-all width is 136 inches and over-all length is 194 inches. Operating weight of the bare tractor is 58,000 pounds.

For more data circle **No. E7** on Readers' Service Card, last page this issue.

SPEEDY—SIMPLE—SOLO OPERATION is achieved by the Cleveland Model 190 whether backfilling heavy dirt—as on this 20-inch Iowa job—or replacing spoil in trench sloped up to 12 feet wide for the biggest diameter lines. The 190's one-man-operation, continuous travel speeds and smoother, larger backfill clutches produce faster, cheaper backfilling than ever before. Your local Cleveland distributor will be glad to show you how! THE CLEVELAND TRENCHER CO., 20100 St. Clair Ave., Cleveland 17, Ohio

(Adv.)

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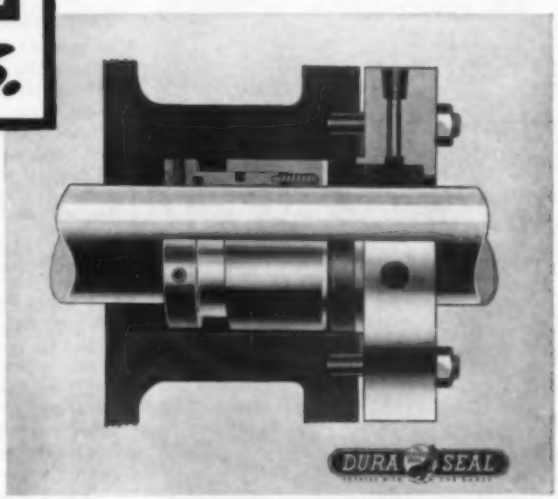
A single Balanced Mechanical Seal for Petroleum Pipe Line Service . . .

Provides perfect sealing for pumps handling crude or products from 100 to 600 lbs. pressure. Can be installed on your present equipment—no special sleeves or machining required.



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HOLDS PARAFFIN IN SUSPENSION

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BRAKESOL is ECONOMICAL, prevents or removes Paraffin from the tubing, flow lines, tank bottoms and pipe lines. Effective on both asphalt and mixed base paraffin.

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ORIFICE PLATES

By MAC-IRON

PAT. PEND.
(Exclusive MAC-IRON process)

ANOTHER SMASH HIT!

- Standard ring gasket—one piece, simple construction, **all plates precision ground**—minimum turbulence.
- Time saving, inexpensive—all measurements established, nothing special, instantly available—pipe fabricating delays eliminated.
- Equipment damage impossible—no bolts to loosen.

You'll want complete information. Write direct today.

The Mack Iron Works Company

Warren and Water Sts. Sandusky, O.

NEW EQUIPMENT

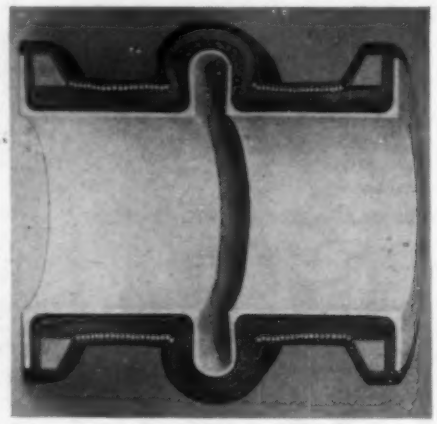
Clamshell Attachment

Ottawa Steel, Incorporated has announced a new clamshell attachment for their industrial heavy duty backhoes which can be installed in less than 20 minutes.

One feature of this clamshell is its down pressure, forward pressure or up pressure which can be used as desired. Operator can actuate either side of the clamshell individually or both sides simultaneously, and automatic ejectors in both sides of the attachment insure full dumping every time.

The clamshell at full opening will dig a 30-inch by 44-inch hole straight down, with straight sides, to a depth of six feet. It will dig a 30-inch by 66-inch hole straight down for 8½ feet, or it will dig a 30-inch by 88-inch hole straight down to a depth of 11 feet.

For more data circle **No. E8** on Readers' Service Card, last page this issue.



Expansion Joints

Rubber expansion joints designed for use with piping and flanges made by Haveg Corporation and The Duriron Company, Inc. have been announced by The Garlock Packing Company.

These expansion joints are made of a high-grade rubber compound combined with plies of sturdy cotton duck and reinforced with steel wire. Steel rings are incorporated in the flange ends of the joint to permit tightening of the connections without shearing the expansion joint.

Special joints are available for the following services: With neoprene lining if some oil is present in the line; with neoprene cover and neoprene lining if, in addition, outside of the joint is in contact with oil; neoprene throughout if the line carries petroleum derivatives; with teflon liner if the line carries liquids or gases harmful to rubber.

These joints are furnished for pipe sizes from one-inch to 12 inches inclusive.

(This item supplements The Garlock Packing Company data on Page 1776 of the Composite Catalog, 20th Edition.)

For more data circle **No. E9** on Readers' Service Card, last page this issue.

Lighting Unit

A complete trailer-mounted lighting unit for the heavy construction industry has been released by the United States Motors Corporation. A 10 KW U. S. engine generator supplies the power, and a series of six 1500-watt lights with full swivel and vertical adjustment supplies broad illumination for construction work. A panel board allows for the individual control of the lights as well as providing receptacle outlets for the operation of power tools.

Lights may be removed and spotted in a variety of positions and distances around the generator. A wide variety of engine and generator sizes for lighting and power are available.

(This item supplements United States Motors Corporation data on Pages 4949-4952 of the Composite Catalog, 20th Edition.)

For more data circle **No. E10** on Readers' Service Card, last page this issue.

Circle numbers on Readers' Service Cards on last page

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Gearing Brochure

Foote Bros. Gear and Machine Corporation has released a new engineering manual on the complete line of Duti-Rated Lifetime Gearing. All standard gear sets available are listed by center distance and capacity to give the most complete and convenient selection possible to suit specific applications.

In addition to illustrating and listing the line, with complete specifications, the book contains material helpful in the selection of proper gear sets. Efficient, space-saving gear arrangements are shown and a section is devoted to gear maintenance tips.

To get a copy circle **No. E11** on Readers' Service Card, last page this issue.

Compressors Bulletin

Gas-engine-driven compressors in the 330 to 660 horsepower range are the subject of a bulletin released by Ingersoll-Rand Company. This bulletin covers all the features of Type SVG four-cycle gas-engine-driven compressors, especially suited for oil field, refinery and natural gas applications.

Important details of these machines are pointed out on cross-section drawings. One special cross-section in five colors traces the paths of fuel, exhaust gases, lubricating oil, cooling water and the gas being compressed. Special sections cover SVG specifications and dimensions and data. The companion gas-engine power unit, the PSVG is also described. Photographs of SVG compressors at work in oil fields, natural gas service, refineries, gasoline plants and in industrial applications are included.

To get a copy circle **No. E12** on Readers' Service Card, last page this issue.

Brazing Manual

The Air Reduction Sales Company has announced publication of a new brazing manual especially concerned with the application of the major brazing methods in joining metals using silver alloys and filler metals, fluxes and gas atmospheres.

Tables, drawings and photographic illustrations are included in the booklet. Subjects discussed concern silver brazing procedure, selection of brazing and filler metals, design of brazed joints, prebraze cleaning, assembly of brazed joints and others.

To get a copy circle **No. E13** on Readers' Service Card, last page this issue.

Safety Manual

A workable, everyday safety manual on industrial safety equipment has been published by Willson Products, Inc. The catalog is divided into four major sections, eye protection, head protection, respiratory protection and welding. Illustrations, descriptions and ordering information have been correlated for simplicity and practicability.

To get a copy circle **No. E14** on Readers' Service Card, last page this issue.

Gas Compressors

"Joy Packaged Gas Compressors" is the title of a new bulletin recently issued by Joy Manufacturing Company. Featured in the two-color bulletin are illustrations of several Joy gas compressor installations in operation and cross-section views of two compressor models. Four basic frame arrangements illustrated show ratings up to 400 horsepower and indicate single or multi-stage compression with from one to four cylinders ranging in size from three inches to 13½ inches.

To get a copy circle **No. E15** on Readers' Service Card, last page this issue.

ECONOMICAL CONSTANT POWER with

SAND-BANUM

Pure Colloidal Concentrate

Safely and Automatically Removes and Prevents Boiler Scale and Corrosion without tools, manual labor or shut-downs.

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SAND-BANUM SPECIAL
in Handy Tablets

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for Clean Fuel Oil Burnability

RUSTEND
Rust Arrestor—Rust Preventor

SABCO—Rust Preventive Aluminum Paint
Two coats in one application.

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705 M & M Bldg., Houston 1, Texas

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AMERICAN SAND-BANUM CO., Inc.
Established 1926
FREEPORT, NEW YORK

GUNITE COATINGS for PIPE LINES

Reinforced GUNITE COATING being applied to pipe.

Your inquiry solicited.

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1301 WOODSWETHER RD., KANSAS CITY 5, MO.
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REPAIR LEAKS
QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.

SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

Advertisers' Index

See Composite and Refinery Catalogs, or Write for Specifications Folder

FLEET-LINE

PIPE SADDLES AND REDUCERS

Nozzle sizes from ¼" to 24"

ASTM A234

Also for pressure vessel heads

Nominal pipe sizes 1" to 30"

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Special sizes and lengths. Schedules 10 to 160

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NEW! Write for Bulletin.

Patented

PIPELINE VENTS AND MARKERS

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SHREVEPORT, LOUISIANA

• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 20th (1953-54) edition of The Composite Catalog of Oil Field and Pipe Line Equipment.

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NOTICE:

No change except the corporate name. We still have the same ownership, same management, same address, same telephone, and use the same 45 years of experience to render the same service under the same trade name—"PELCO."

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PELICAN SUPPLY CO. INC.

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SEE YOUR NEAREST SUPPLY HOUSE

No pipeline job too tough for our experienced organization

SINCE 1926

a hundred mile investment...

is worth protection

And Kontol offers the best. Whether your pipe lines are measured in miles, hundreds of miles or thousands of miles – corrosion, fouling and *scaling* are potential hazards. Kontol inhibitors offer proved protection against corrosion; they also have effective detergent characteristics which have demonstrated outstanding line-cleaning action.

A typical case in point was a 385 mile, 6" product line in the eastern area, originally designed to handle 12,000 bpd. After preliminary scraping to remove loose scale, Kontol 118 was injected at the rate of one gallon per thousand barrels of throughput. Shown below is a summary of the results obtained.

LINE	"C" FACTOR BEFORE KONTOL*	AFTER KONTOL**
Pump Station 2 to 3	132	138
Pump Station 3 to 4	135	142
Pump Station 4 to 5	138	145
Pump Station 8 to 9	118	135

*Scrapers only **Kontol and scrapers

THROUGHPUT INCREASE: 720 barrels per day
ESTIMATE SCALE REMOVED: 16 tons

After the line was cleaned, Kontol 77 was injected into the line to control acidic corrosion and oxidation. This treatment will also aid in maintaining a high "C" factor.

Laboratory tests have conclusively proved that Kontol 118 and Kontol 77, at concentrations of one gallon per thousand barrels of hydrocarbon, have no detrimental effect on product quality.

For complete information on how Tretolite Company products and services can help you protect your pipeline investment, call your Tretolite service engineer, or write to

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DESALTING • SCALE PREVENTING • WATER DE-OILING • PRODUCTION STIMULATION
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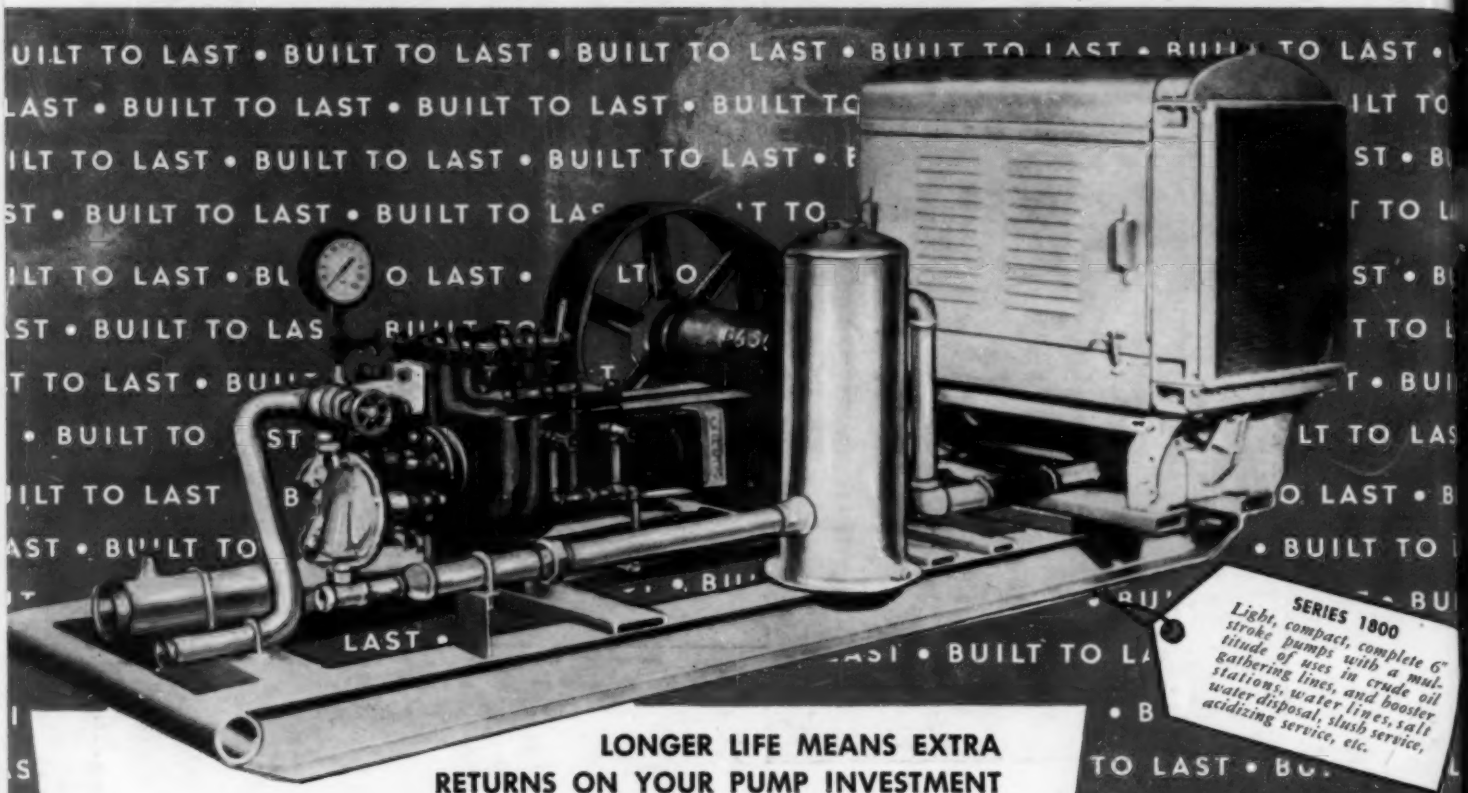
PIPE LINE INDUSTRY

CONSTRUCTION

OPERATIONS

MAINTENANCE



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Light, compact, complete 6" stroke pumps with a multitude of uses in crude oil gathering lines, and booster stations, water lines, salt water disposal, slush service, acidizing service, etc.

LONGER LIFE MEANS EXTRA RETURNS ON YOUR PUMP INVESTMENT

BUILT TO LAST

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for every oil industry need